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Adaptive Futures for SE Australian Fisheries & Aquaculture: Climate Adaptation Simulations

2010/023 - Quantitative testing of fisheries management arrangements under climate change using Atlantis

Elizabeth A. Fulton, Rebecca Gorton

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Researcher Contact Details

Name: Dr Elizabeth Fulton
Address: CSIRO, GPO Box 1538
Hobart, Tasmania, 7001
Phone: +61-3-62325018
Email: beth.fulton@csiro.au

FRDC Contact Details

Address: 25 Geils Court
Deakin ACT 2600
Phone: 02 6285 0400
Fax: 02 6285 0499
Email: frdc@frdc.com.au
Web: www.frdc.com.au

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Executive summary

This report summaries a multi-year effort to model potential futures for southeastern Australian marine and coastal waters under climate change. The work was part of a multi-partner collaboration formed to provide information in support of understanding and risk assessment. The membership of the group included State and Commonwealth agencies, CSIRO, the University of Tasmania and the Fisheries Research and Development Corporation. Together, this collaborative group developed a South-Eastern Australian Program to address adaptation of fisheries and aquaculture to climate change through coordinated action, which included social research on decision drivers, impact and risk assessment methods. The modelling work presented in this report was a means of synthesizing all the available information so that potential alternative futures could be explored. The outcome of these simulations can then provide guidance for policy makers on the advantages and problems associated with a range of management arrangements and development scenarios.

Climate change will be a driver that influences ecosystems and the sustainability of industries dependent upon them, in turn impacting on the value of resources and ecosystem services to the community. Biophysical consequences of global change are likely to include changed oceanic conditions (e.g. currents, temperatures, sea levels, winds, stratification, oxygen concentrations, nutrient availability, pH and extreme events), which are expected to impact the distribution and abundance of habitats, flora and fauna; and then fisheries distributions and productivity in turn; which then influence markets, food security, social and economic flow-on effects. Moreover, global and national policy responses for mitigating and adapting to global change are expected to influence input costs (e.g. fuel and bait); providing challenges for existing business, but also opportunities for new kinds of businesses.

Southeast Australia is a global hotspot for climate change (Hobday and Pecl 2014), but is also amongst some of the most productive in Australia. In addition, they are the location of many marine industries and a large proportion of Australia's population. For industries, such as fisheries and aquaculture (two important industries in the region), and societies who rely on marine resources, to remain viable despite the changes they will need to adapt to change and uncertainty, as they have adapted to many other changes through time. The response of these industries and communities will be dependent upon how well prepared and adaptable the sectors, management and communities are. A sound risk-based and integrated approach is critical for informing the decisions of sectors and management in preparing for climate change.

This project used end-to-end (whole-of-system) ecosystem models to help understand both the form of potential changes, but also potentially resilient adaptation and management options. End-to-end ecosystem simulation models, like Atlantis, have been recognised as an effective means of consider many of the interacting components of socio-ecological systems (biophysical, social and economic) and can be a useful tool for synthesising information, clarifying system understanding, exploring tradeoffs, opportunities and challenges, laying out potential outcomes and highlighting contradictory, uncertain or missing information. These models explicitly include the spectrum of system processes and components needed to represent all the system components (e.g. environment, food webs, habitats and all relevant marine industries; including recreational and commercial fisheries and aquaculture).

Atlantis models have a decade plus history of use in the southeast marine region of Australia, in both Commonwealth and State waters, where they have been used to consider the broader regulatory context of the system (e.g. potential alternative futures for the Southern and Eastern Scalefish and Shark Fishery; Fulton et al 2014). These models were further refined for this project so that they included biodiversity and evolution in addition to the social drivers, economic (and market) components, biophysical aspects of climate change and the main management types in the region (including closures, incentive-based structures and gear controls). The objective of the project was then to use these models to:

1. Assess the challenges to recreational and commercial fisheries and aquaculture management arrangements within a changing climate

2. Identify potential barriers (for both Government and industry) to adaptation
3. Inform on changes to management arrangements that could provide for sustainable management of the resource, provide for efficient operation of markets, foster industry adaptation and enable businesses to manage challenges and take advantage of any emerging opportunities in the face of uncertainty that will be associated with future climate impacts
4. Determine how to detect and attribute significant changes to the system to inform a management response in the face of considerable on-going uncertainty

The results of the Atlantis models suggested that six types of potential barriers to adaptation are active in southeast Australia, with the anthropogenic ones potentially posing the greatest future challenges. The first type of barrier is related biological and ecological processes, such as shifts in primary productivity, or changing abundance and spatial distribution of species that may disrupt the ecosystem. Across the range of management strategies, parameterisation and potential emissions scenarios explored using the models there is a non-linear relationship between the level of emissions (climate change scenario), biodiversity and socioeconomic state, with a threshold point occurring around 550-560ppm of atmospheric pCO_2e. Prior to this point the ecosystem components are largely biologically capable of adapting, meaning that associated socioeconomic impacts of changes in target species and their food webs is less than the extremes suggested by taxonomically based exposure assessments. However, beyond 550ppm biological adaptation and acclimation appears to be overwhelmed, with species relying on spatial range shifts as the major coping mechanism – ultimately potentially running out of shelf habitat in the 2070s. This level of change can express itself in regime shifts, particularly off Eastern Bass Strait resulting in a significant shift in productivity and system structure – often favouring cephalopods and other pelagic fast growing, small bodied species. Chondrichthyans also often perform well, but this may be a model artefact as little is known of their likely responses to environmental shifts.

The remaining barriers to adaptation are all to do with the human components:

- Fisher behavioural barriers to adaptation are driven by personality and many forms of capital, together they mean that not all fishers have equal flexibility to respond and adapt, with the smaller operators apparently the least able to cope;
- Governance and regulatory barriers to adaptation may be minimised under sound sustainable adaptive management (and can support a transformational change), but features of the regulatory system may still inhibit adaptation, either via allowing fisheries to synergistically interact with environmental change to exacerbate ecological shifts, or by imposing delays in the management system, or by promoting strategies that cause economic and social hardship lowering adaptive capacity;
- Economic and market related barriers to adaptation may be confounded by social drivers, or may be shaped by short term drivers which can act counter to what is required for long term adaptation;
- Technological barriers to adaptation are only beneficial if technologies needed to change targeting or other behaviours exist, or if current technology encourages behaviours or system changes that are adaptive;
- Knowledge based barriers to adaptation can undermine adaptive management and system understanding, which is reliant on quality information, this means uncertainty, insufficient information or poor communication can hinder decision making and stall adaptation.

Significant social, market and industry adaptation is required to remain viable through such trying times. For example, seafood markets may need to be much more diverse in 2050-2070.

Overall integrated management has the most consistent and balanced performance relative to conservation, industry and economic objectives. Specific management options (such as extensive spatial management) can out perform integrated management for a sub-set of objectives, but at the expense of performance in terms of other objectives. The synergistic action of changes in ocean temperature, ocean acidification and human use on southeast Australian marine ecosystems supports previous suggestions that effective resource management is an effective means of providing ecosystems with an improved capacity for adaptation. For example, in offshore systems paying careful attention to the management of mesopelagic species may provide greater than expected returns in protecting the food web from both direct and indirect synergistic effects of fishing and climate change on predator-prey relationships.

While integrated adaptive management across all sectors active on the shelf and in the coastal zone leads to the most robust system state, some of the required regulatory and industry shifts are currently unpalatable to at least some segments of Australian society. For instance, the simulations showed that effective management is required across fisheries; this would require more stringent regulation of recreational fishing (which is effectively open access at present). Simulations also indicated that smaller boats that were socially tied to a specific geographic region (and port) were economically vulnerable to the loss of target species, but also ecologically damaging. This is because they caused more localised depletions, as they were forced to rely on nearby (and potentially marginal) stocks instead of being able to shift to the location of the most robust stocks. This means that either the society at large would need to be carefully led through why larger vessels are required (and can be used sustainably), so as to avoid the kind of controversy seen in 2013 around the potential use of a "super trawler". Alternatively, industry or government restructuring and resettlement plans would be periodically required to relocate and refit the vessels according to new ecological states. Inertia in the management system (e.g. lags in multi-year assessments) and industry responses have serious implications for stock status and harvest volatility when system productivity is changing.

It must be stressed however that while system models can be useful learning tools they are the mathematical equivalents of cartoons of the system; useful caricatures but not a crystal ball. They can provide ideas around challenges that alternative futures may hold, but they are unlikely to predict the exact form any one future will take. This is why it will be important to follow up on this work by trying to reduce some of the uncertainty evident in the broad range of possible outcomes seen under the model parameterisations. Good decision-making is reliant on good information, sustained observing of the marine system is required to really detect and attribute current and future changes. Such data streams would help constrain uncertainty. More targeted information is also required. Improved understanding of responses of species from southeast Australia, especially large-bodied species like sharks (etc.) needs to be gained as rapidly as possible to determine which species are most likely to be impacted in future and where management attention is most needed. Scientifically there is also a need for more dedicated modelling tools targeting species that may have a future spatial distribution pattern that is drawn out over source and sink locations, complicating management across jurisdictions. There would also be significant benefit in initiating discussions around what would be required to operationalize integrated adaptive management (across all users of the marine and coastal environments).

A key step in making sure that maximum benefit is gained from the modelling work and the SEAP body of work more broadly is to make sure it is broadly disseminated. To that end the **sea**view (www.csiro.au/seaview) and Redmap websites (www.redmap.org.au) will be updated and cross connected so that all results and factsheets are publically available. Simple animations could also be done to communicate the major findings from the work in a simple form. A couple of animations are already under development and will be posted to the seaview website, but there is plenty of scope for future targeted projects to create a larger library of animations for communication purposes. Given the sensitivity of the system to barriers to adaptation associated with human responses, education around potential changes and adaptation strategies (across all parts of society) are very important if maladaptive responses are to be avoided.

Keywords

Climate change, adaptation, fisheries, aquaculture, ecosystem modelling, management strategy evaluation

Objectives

The objectives of this model-based research were

1. Assess what the challenges are for recreational and commercial fisheries and aquaculture management arrangements within a changing climate
2. Identify potential barriers (for both Government and industry) to adaptation
3. Inform on changes to management arrangements that provide for sustainable management of the resource, provide for efficient operation of markets, foster industry adaptation and enable businesses to manage challenges and take advantage of any emerging opportunities all in the face of uncertainty associated with climate impacts
4. Determine how to detect and attribute significant changes in the system to inform a management response in the face of considerable on-going uncertainty

Introduction

Global change via cumulative human action on Earth's systems has the potential to reshape the environmental conditions experienced in Australia's southeast, with the region already identified as a global hotspot (Wu et al 2012, Hobday and Pecl 2014). The latest IPCC scenarios for fossil fuel emissions (Moss 2010) suggest that within the next 60-100 years ocean surface temperatures are likely to warm by 1.8 - 4°C, sea level is predicted to rise by 0.2-1.0m, ocean acidification may lead to declines in pH of 0.14-0.5 (IPCC 2013, 2014) and storms are likely to intensify (Knutson et al 2010). The projected rise in global population to 9 billion by 2050 (UN 2009) is also expected to see the majority of the worlds population concentrated along coastal fringes (Small et al 2000, CCSR 2006), much as it is already in Australia (ABS 2012). The combination of rising and intensifying coastal populations, marine resource use and environmental change has the potential to impact upon many critical marine ecosystem services (Cheung et al 2008, Cheung et al 2009, Fulton 2011, Barange et al 2014).

Marine species are influenced by their surrounds and the shifting pressures in the southeast region of Australia are already leading to significant shifts in the distributions of some species (Last et al 2011, Pecl et al 2011), and are likely to alter survivorship (Fabry et al 2008; Hall-Spencer et al 2008), foraging and reproductive success (Kleypas et al 2006, Widdicombe and Spicer 2008, Bograd et al 2009, Doney et al 2009, Munday et al 2009). This ecological change has the potential to shift species distributions and community compositions, which in turn has fisheries and other social and economic implications (Fulton 2011, Griffith et al 2011, Griffith et al, Barange et al 2014). The majority of recent projections (IPCC 2013, IPCC 2014, Barange et al 2014) indicate that these shifts will not all be negative, with many opportunities available for Australian (and global) fisheries and aquacultural production so long as Australian industry and society has sufficient adaptive capacity to make the most of opportunities presented.

Adaptation and transformational change is the focus of extensive and growing bodies of literature. All forms of capital – natural, built, human (including psychological), knowledge, financial and social – have been considered in terms of the barriers to adaptation (Adger and Vincent 2005, Marshall and Marshall 2007, Cinner et al 2009, Productivity Commission 2012). Nevertheless the feedbacks between the different forms of capital has not received as much attention, with shifting system structure lowering some barriers, but potentially raising or strengthening others. For example, demographic truncation, evolution to smaller size and restructuring of food webs (Frank et al 2005, Ottersen et al 2006, Audzijonyte et al 2013a) towards faster turnover "weedier" species, altering responses to environmental shifts (Planque et al 2010).

Improved knowledge of interactions between ecosystem components and cumulative stressors has the potential to allow for more informed decision-making that breaks away from classical approaches that have typically been based on combating specific individual effects (Crowder et al 2006). While it is true that dealing with multiple stressors is non-trivial, simulation models that reproduce key features of the combined system provide a valuable test-bed for exploring potential alternative futures (Fulton et al 2014) and identifying potential barriers to adaptation that arise from the kinds of multifaceted interactions typical of systems as complex as those in Australia's south eastern marine and coastal waters (Travers et al 2007, Fabry et al 2008, Doney et al 2009, Blackford 2010, Fulton 2011).

This report presents the outcomes from a simulation-based analysis of the potential futures of these southeastern marine ecosystems, fisheries and associated aquaculture industries. It considers how the ecosystem and human use may be reshaped into the future and what barriers to adaptation may exist within the system.

Method

Management Strategy Evaluation

The simulations used to explore the alternative futures represented in this report were done in the context of a management strategy evaluation (MSE) framework. This is a simulation-based technique which attempts to model each part of the adaptive management cycle (de la Mare 1996, 1998; Figure 1). Evidence based decision making and updating that underlies adaptive management can be undermined in situations like that faced under climate change. This is because of delays in responses so that adaptive iterations occur on generational time scales and because decisions could have highly undesirable or irreversible outcomes. It is desirable in such circumstances to simultaneously evaluate multiple alternatives; the advantage of doing that via simulations is that it can happen with rapidity free of real world consequences for the poor performing options. Lastly, such a model based process also provides learning tools, so that a broad range of stakeholders can have input and modify requests in response to emerging concerns and changing circumstances (for instance a decade ago ocean acidification was rarely mentioned where it is now a chief concern for bivalve aquaculture in some locations).

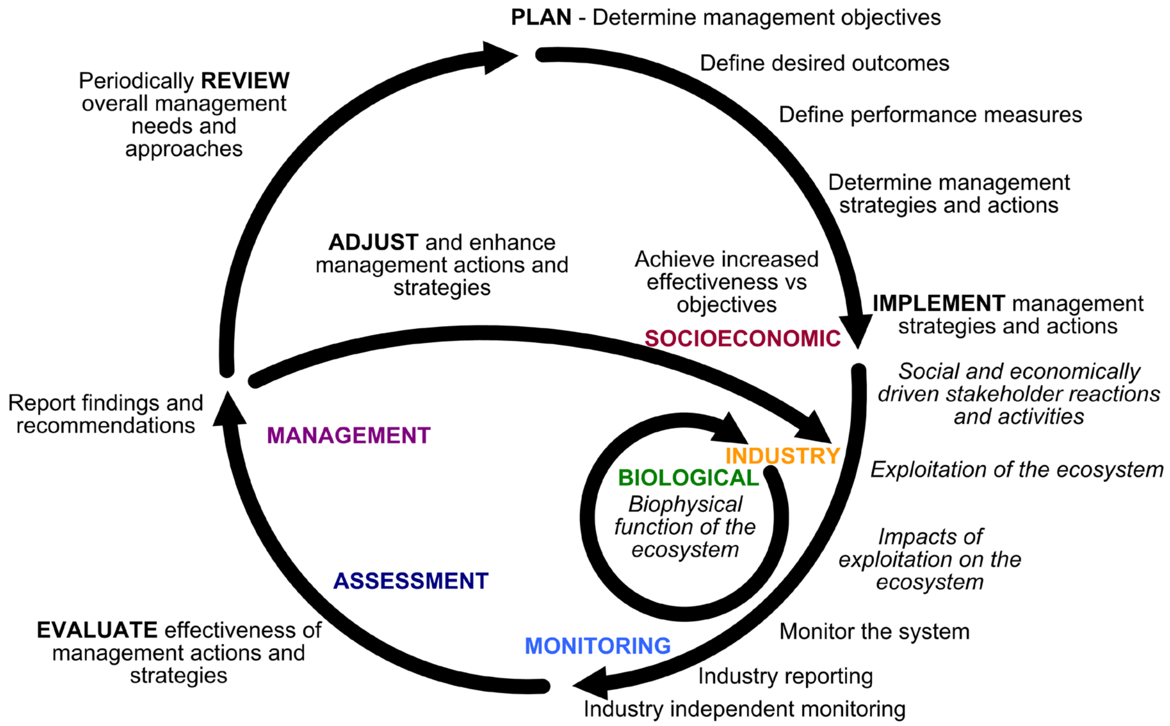


Figure 1: Diagrammatic description of the adaptive management cycle (based on Jones 2009).

MSE has been used in fisheries for more than two decades, with the method now widely accepted as a best practice approach for single stock and ecosystem-level management questions. The MSE approach is the corner stone of assessments by international bodies such as the International Whaling Commission (e.g. IWC 1992, Kirkwood 1997) and CCAMLR (de la Mare 1996), but also national fisheries departments in South Africa (Punt and Butterworth 1995, Cochrane et al 1998, Butterworth et al 1998); Europe (Horwood 1994, as of Butterworth and Punt 1999); New Zealand (Starr et al 1997); Australia (Punt and Smith 1999) and some of the US fisheries councils (e.g. North Pacific Fishery Management

Council). Useful reviews of the approach can be found in Butterworth and Punt (1999), Sainsbury et al (2000), Rademeyer et al (2007) and Bunnefeld et al (2011).

A particular strength of the MSE approach is that it does not try to find a single optimal solution based on a single model. Instead alternative strategies and hypotheses are evaluated using multiple candidate models. In this way the outcomes can then be evaluated across the models to check for the robustness of the results given uncertainty in parameters, connections (e.g. in the food web or social networks), responses and mechanisms. One way of visualising this array of alternatives is as a cube, with dimensions spanning biological and environmental uncertainty as well as the management strategies of particular interest (Figure 2) – where each cell (square) in the cube represents a realised combination of biological uncertainty, environmental uncertainty and management strategy. In this study three emission scenarios, two ecosystem models (each with multiple productivity and food web parameterisations), eighteen system contexts and nine management strategies were evaluated. Each of these aspects is described in more detail below.

As the full set of combinations wasn't computationally tractable all management options were run for both a 2010 system context and a full cumulative change ("worst case") scenario, as this will bound the extent of possible outcomes. Then to give insight into how other contexts may sit between these extremes the other contexts (e.g. blooms, productivity shifts, shifted markets, new fisheries, range extending species etc) were run under the best performing (integrated) management. This set of simulations was repeated under alternative emissions scenarios – the IPCC defined Representative Carbon Pathways (RCP) 3, 4.5 and 8.5. For reference (as comparative controls), versions of the status quo and cumulative change scenarios were run (i) with no climate shifts and (ii) without evolution and acclimation. In total 310 simulations were run for each of the Atlantis models - Atlantis-SE and Atlantis-SEAP.

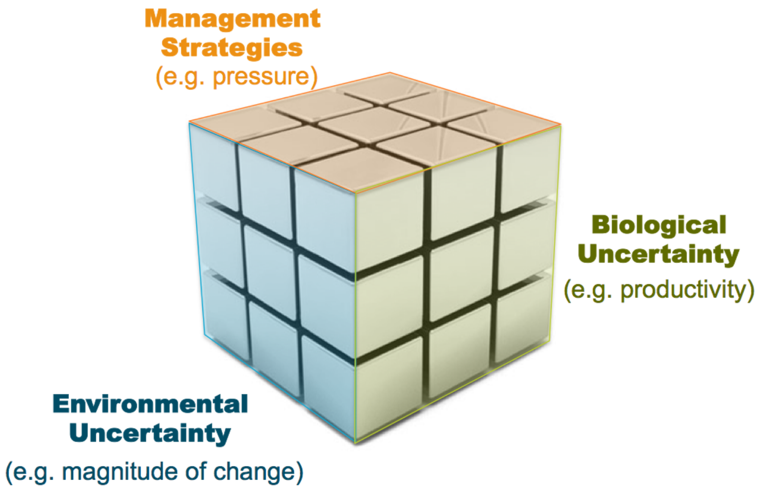


Figure 2: Visualisation of the axes of uncertainty (biological and environmental) versus the management strategies of interest in a management strategy evaluation. Each square represents a realised combination of biological uncertainty, environmental uncertainty and management strategy.

Atlantis

The modelling framework used as the basis of this MSE was Atlantis, which is a whole of system (or end-to-end) ecosystem model (Fulton et al 2007, Fulton et al 2011a, Fulton et al 2014) that has been implemented in a large number of systems around the world (Figure 3). Atlantis includes representations of each significant component of the adaptive management cycle - biophysical system, human users (industry) and their socioeconomic drivers, monitoring, assessment and management decision processes (Figure 4). All of these components are dynamic and two-coupled (i.e. they interconnect and feedback on each other within a simulation).

Atlantis is not a single model, it a modelling toolbox that allows the user to make a model out of the many different options available for each process represented in the model. Consequently a full exposition of the Atlantis equations is not feasible here, but documentation and access to the code is available on a wiki at http://atlantis.cmar.csiro.au/.

For the purposes of exploring alternative futures for southeast Australian fisheries and aquaculture two ecosystem models were used. One focusing more on the commonwealth waters (Atlantis-SE) and one more detailed for shelf waters (Atlantis-SEAP). Both of these models are deterministic, with (coarsely) spatially-resolved 3D biophysical sub-models that track nitrogen and silica flows through the food web on a 12 hour time-step. Ecologically the model explicitly represents consumption, production, waste cycling, movement, recruitment and habitat dependency. Physiological responses to ocean pH, acclimation and evolution were also specifically added for this project. The physical environment (including water and substrate properties and processes) are represented using irregular polygons matched to the major geographical and bioregional features of the simulated marine system. The anthropogenic components of the model represents the impact of pollution and coastal development, but is focused on the detailed dynamics of fishing fleets and management regimes. The exact form used can again be drawn from a wide list of options. Atlantis-SE includes explicit socio-economically driven effort allocation, while Atlantis-SEAP uses a simpler CPUE based effort allocation model. Both Atlantis models used here incorporate regulation based on gear restrictions, individual transferable quotas, spatial and temporal zoning, discarding restrictions, size limits, bycatch mitigation, and dynamic reference points and decision rules.

Figure 3: Map of Atlantis model implementations (current as of March 2014). The teal polygons represent working models and the orange circles are proposed models that are yet to be implemented. Around Australia, the US and European coasts there are multiple nested models.

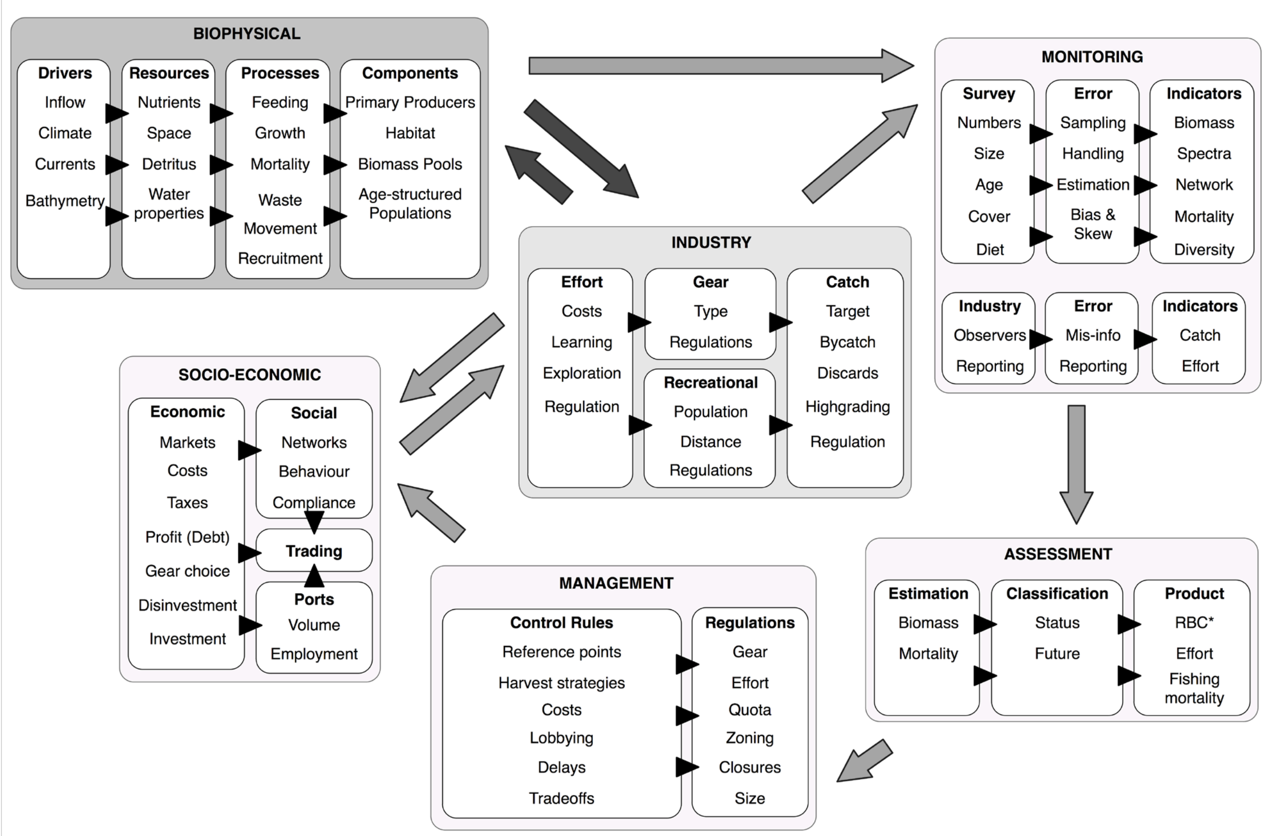


Figure 4: Schematic diagram showing major components of the Atlantis modelling framework (as of Fulton et al 2011b). RBC stands for recommended biological catch

Calibrating Atlantis models is quite challenging, as data sets of sufficient size to fully fit such large models are rare – typically non-existent requiring the modeller to combine information from many sources. Atlantis-SE has been calibrated ecologically against 36 separate 20-90 year catch time series and sporadic scientific surveys. Anthropogenically, spatial effort time series (of 17-20 years) were used to train and test the effort allocation model (see Fulton et al 2007). Atlantis-SEAP was calibrated using observational time series from inshore marine reserves in Tasmania (Barrett et al 2007) and Victoria (Gilmour et al 2005) as well as unpublished data provided by Fisheries Victoria (for target species such as abalone and lobster).

Calibration is performed using a simple implementation of pattern-oriented modelling. This approach simultaneously fits the entire model against data from multiple datasets (Kramer-Schadt et al 2007). In this way bounding parameterisations were found that produce equally plausible modelled systems given the available data and alternative possible system structures.

Atlantis-SE: a model of Australia’s south eastern EEZ

The model used as a basis for this study is an updated form of Atlantis-SE (Fulton et al 2007), which is one of the most sophisticated system level representations of a marine system developed anywhere in the world to date. It has previously been used to consider alternative management strategies for the SESSF (Fulton et al 2014), robust indicators of ecosystem change (Fulton et al 2005, Branch et al 2010), the status of global fisheries (Worm et al 2009), alternative means of exploiting ecosystems (Garcia et al 2012), the effects of the depletion of forage fish (Smith et al 2011a), implications of future climate change (Fulton 2011), ocean acidification (Griffith et al 2011, 2012), and shifting physiological growth rates as a result of fisheries induced evolution and climate pressures (Audzijonyte et al 2013b, 2014).

Model domain

The geographic extent of Atlantis-SE is 3.7 million km^2 of Australia's southeastern EEZ (24°21'S, 160°30'E to 46°51'S, 117°48'E; Figure 5). It includes many different kinds of geomorphological and bathymetric features including large bays and gulfs, coastal waters, the continental shelf and slope, seamounts, submerged canyons and the open ocean. The area includes tropical, subtropical, cool temperate and subantarctic environments (Bulman et al 2006). Warm tropical poleward flowing currents (Leeuwin Current and East Australian Current), bring warm water biota to southern latitudes (May and Blaber 1989, Bax et al 2001) and make the region one of the fastest warming marine areas on the globe (Cai et al 2005, Wu et al 2012).

Atlantis-SE uses by 71 polygonal boxes, with up to 5 vertical layers per box, to represent the region (Figure 5). These boxes are based on physical, chemical and ecological properties and distributions captured in a demersal bioregionalization (IMCRA 1998, Butler et al 2001, Lyne and Hayes 2005) and an independent pelagic analysis using the CSIRO Atlas of Regional Seas data set (http://www.cmar. csiro.au/cars). Deeper boxes have the full 5 layers, down to a total depth of 1800 m, with shallower boxes having fewer layers (truncating at the seafloor). For open ocean boxes in water deeper than 1800 m the water below this depth is omitted with the base of the box treated as an open boundary so deep water can mix in from outside the model domain (this is also what occurs horizontally in all layers adjacent to oceanic boundary boxes that edge the model domain).

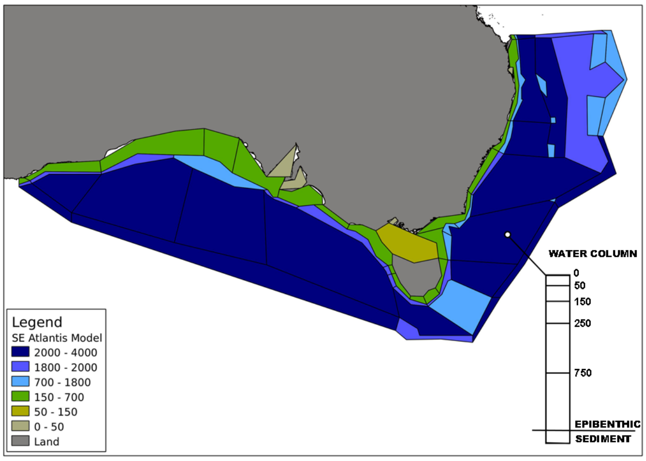


Figure 5: Map of polygons (and depth structure within polygons) used to represent the spatial areas in Atlantis-SE

Ecological structure

Atlantis-SE has quite a complex ecology. The functional groups (some resolved to a species level) are defined based on aggregating species with similar size, diet, predators, habitat preferences, migratory patterns and life history strategy (full list given in Table 1). In this way the model represents a size resolved microbial web; biomass pools of pelagic and benthic invertebrates; and age structured stocks of cephalopods, prawns and vertebrates (from forage fish to top predators). In addition to these living biological groups, pools of ammonia, nitrate, silica, oxygen, carrion, labile and refractory detritus are also represented dynamically.

Distributions and physiological responses are dictated by the water conditions (temperature, salinity, oxygen and pH) and primary production is conditioned by nutrient, light and available space. The vertebrate groups are represented using multiple genetic stocks per group (primarily split east and west of Bass Strait), with gape limited feeding, habitat dependency and shifting climate-related environmental drivers for their physiology, spatial distribution, movement and reproduction. Further details of how these biological components were originally parameterised are given in Fulton et al (2007). The ecological components of the model were refined based on information in Pecl et al (2011). In addition an alternative diet structure (allowing for a more changeable diet in line with the degree of flexibility observed in the North Sea and on Georges Bank over the last century – CEFAS data sets). All of these alternative parameterisations were then all carried forward in the various simulations done for the final analyses (summarised as the "intermediate", "pessimistic" and "alternative trophic structure" ecological parameterisations in the remainder of the report).

Table 1: List of biological components in Atlantis-SE

MODEL COMPONENT	GROUP COMPOSITION
Pelagic invertebrates & flora	
Large phytoplankton	Diatoms
Small phytoplankton	Picophytoplankton
Small zooplankton	Heterotrophic flagellates
Mesozooplankton	Copepods
Large zooplankton	Krill and chaetognaths
Gelatinous zooplankton	Salps (pryosomes), coelenterates
Pelagic bacteria	Pelagic attached and free-living bacteria
Squid	*Sepioteuthis australis, Notodarus gouldi*
Benthic invertebrates & flora	
Sediment bacteria	Aerobic and anaerobic bacteria
Carnivorous infauna	Polychaetes
Deposit feeders	Holothurians, echinoderms, burrowing bivalves
Deep water filter feeders	Sponges, corals, crinoids, bivalves
Shallow water filter feeders	Mussels, oysters, sponges, corals
Scallops	*Pecten fumatus*
Herbivorous grazers	Urchins, *Haliotis laevigata, Haliotis rubra*, gastropods
Deep water megazoobenthos	Crustacea, asteroids, molluscs
Shallow water megazoobenthos	Stomatopods, octopus, seastar, gastropod, and non-commercial crustaceans
Rock lobster	*Jasus edwardsii, Jasus verreauxi*
Meiobenthos	Meiobenthos
Macroalgae	Kelp
Seagrass	Seagrass
Prawns	*Haliporoides sibogae*
Giant crab	*Pseudocarcinus gigas*
Fin-fish	
Small pelagics	*Engraulis, Sardinops,* sprat
Red bait	Emmelichthyidae (*Emmelichthys nitidus*)
Mackerel	*Trachurus declivis, Scomber australisicus*
Migratory mesopelagics	Myctophids
Non-migratory mesopelagics	Sternophychids, cyclothene (lightfish)
School whiting	*Sillago*
Shallow water piscivores	*Arripis, Thyrsites atu, Seriola,* leatherjackets
Blue warehou	*Seriolella brama*
Spotted warehou	*Seriolella punctata*
Tuna and billfish	*Thunnus, Makaira, Tetrapturus, Xiphias*
Gemfish	*Rexea solandri*
Shallow water demersal fish	Paralichthyidae, Pleuronectidae, *Pagrus auratus*, Labridae, *Chelidonichthys kumu, Pterygotrigla, Sillaginoides punctata, Zeus faber*
Flathead	*Neoplatycephalus richardsoni, Platycephalus*
Redfish	*Centroberyx*
Morwong	*Nemadactylus*
Ling	*Genypterus blacodes*
Blue grenadier	*Macruronus novaezelandiae*
Blue-eye trevalla	*Hyperoglyphe antarctica*
Ribaldo	*Mora moro*

MODEL COMPONENT	GROUP COMPOSITION
Orange roughy	*Hoplostethus atlanticus*
Dories and oreos	Oreosomatidae, Macrouridae, Zenopsis
Cardinalfish	Cardinalfish
Sharks	
Gummy shark	*Mustelus antarcticus*
School shark	*Galeorhinus galeus*
Demersal sharks	*Heterodontus portusjacksoni*, Scyliorhinidae, Orectolobidae
Pelagic sharks	*Prionace glauca, Isurus oxyrunchus, Carcharodon carcharias, Carcharhinus*
Dogfish	Squalidae
Gulper sharks	*Centrophorus*
Skates and rays	Rajidae, Dasyatidae
Top predators	
Seabirds	Diomedeidae, *Puffinus*, Laridae, *Morus*, *Eudyptula minor*
Seals	*Arctocephalus pusillus doriferus, Arctocephalus forsteri*
Sea lion	*Neophoca cinerea*
Dolphins	Delphinidae
Orcas	*Orcinus orca*
Baleen whales	*Megaptera novaeangliae, Balaenoptera, Eubalaena australis*

Fisheries

Atlantis-SE explicitly represents 33 fleets (Table 2) – 32 commercial fleets and a recreational fleet (including leisure craft and charter vessels). These fleets are resolved in to sub-fleets defined by home ports, gear types, habitat association, targeting, crew and vessel sizes. The distribution and magnitude of the commercial effort is driven by social and economic drivers that determine investment, disinvestment, quota trading, and information updating. The recreation fishing pressure is based on the distance from the coast and the human population of the adjacent terrestrial areas. Fulton et al (2007) provides further detailed explanations of how the fleets were originally defined. Some updating of economic parameters, using information sourced from fuel markets, operators and AFMA were undertaken as part of this project.

While the recreational catch is represented as a simple tithe, the commercial harvest levels dynamically simulated in the model are based on a model of fisher behaviour that responds to available quota, costs and shifts in catch rates spatially, temporally and across the different species caught. Details of the formulations used in effort allocation and quota trading are given in Fulton et al (2007).

In terms of management, the area is under a number of fisheries jurisdictions. The regulatory areas and methods of the Australian Fisheries Management Authority (AFMA) of particular focus in the original Atlantis-SE model, but this dynamic representation was expanded to the state-based fisheries for this project. However the management representation for the state fisheries and zoning regulations were still relatively rudimentary in Atlantis-SE, with more focus put on those areas in Atlantis-SEAP. The management model used in Atlantis-SE included monitoring and assessment with dynamic setting of quotas through time. Other forms of management (e.g. spatial zoning) were static – defined by the management strategy.

Beyond fisheries, the southeast region of Australia is subject to zoning under a regional marine plan (NOO 2004) and smaller industry specific exclusion zones around defence sites, energy installations, shipping routes, pipelines etc. These other zones were overlaid on the fisheries restrictions represented in the model.

Atlantis-SEAP

Atlantis-SEAP is an inshore equivalent to Atlantis-SE. The two models cover roughly the same geographic extent, but they focus on different sets of taxa – with Atlantis-SEAP concentrating on species groups living in waters of less than 250m. This inshore focus means it can give greater attention to shelf species and aquaculture. The later, in particular, cannot be usefully resolved in Atlantis-SE. The two models together give a complimentary perspective on the alternative futures of Australia's southeast waters.

Model domain

The geographic extent of Atlantis-SEAP is essentially an extended version of an earlier Atlantis model – Atlantis Spatial Management (Atlantis-SM) developed by Johnson et al (2011). In creating the Atlantis-SEAP model the geographic extent was defined to extend from the central South Australian border in the west, to the New South Wales/Queensland border in the northeast and the shelf area of Tasmania in the south. Thus the coverage includes the full coast of Victoria, Tasmania and New South Wales, and partial coverage of the South Australian coastline (Figure 6). This extension into New South Wales and South Australian waters could not continue the 'telescoping' approach used around Victoria and Tasmania's east coast as insufficient data was available[1]. Instead, these areas of the models were defined based on the biogeography of the regions, in the same way boxes were defined for Atlantis-SE. For the purposes of this project this mixed spatial structure was not an issue as it made best use of available data and a universally fine spatial resolution was not necessary for representing management strategies and scenarios of interest.

[1] Telescoping uses fine boxes inshore, based on sediment and habitat maps, through to coarser cells offshore, which match those in Atlantis-SE.
[2] Given the extensive nature of the meta-analysis used, instead of overwhelming the text of this report the database of papers is available from Beth Fulton on request.
[3] In response to the individual state managers responding to pressure from the recreational fishing lobby when setting annual management

Table 2: Summary table of fisheries (fleets and fleet components) represented in Atlantis-SE - recreational fishing includes fishing from charter boats. Forced = fixed effort level and distribution as of 2000, dynamic = uses a dynamic effort allocation model to execute fishing. Depths represents potential depths fished, fisheries did not automatically fish all potential depths at any one time or even during the course of an entire run. Note that fisheries could target many more groups than just the primary target and that the primary target group is for the start of the dynamic runs, within a run the identity of the primary target group could change as a result of decisions made by the dynamic fisheries.

FISHERY (FLEET)	FLEET COMPONENT	GEAR	DEPTHS (M)	PRIMARY TARGET GROUP(S)	EFFORT MODEL	SUBFLEETS
Dive	-	Dive	< 35	Grazers, lobster, deposit feeders	Forced	All size boats together
Fin-fish auto-longline	-	Auto-longline	150 - 600 [A]	Ling, blue grenadier, blue-eye trevalla	Dynamic	All size boats together
Fin-fish drop line	-	Drop lines	150 - 650	Blue-eye trevalla	Dynamic	All size boats together
Fin-fish mesh net	-	Mesh nets	150 - 250	Warehou	Dynamic	All size boats together
Fin-fish trap	-	Traps	150 - 550	Ling and demersals	Forced	All size boats together
Inshore line	-	Drop and hand lines	< 200	Shallow piscivores	Forced	All size boats together
Pots	-	Traps	< 250	Lobster, shallow megazoobenthos	Forced	All size boats together
Recreational	-	Multiple	< 200	multiple	Dynamic	Individuals
(represented as a tithe)						Charter boats
Scallop dredge	-	Dredge	< 150 [B]	Scallops	Forced	All size boats together
Shark net	-	Mesh nets	< 150 [C]	Gummy shark, school shark	Dynamic	< 30m
						30 – 40m
						> 40m
Shark longline	-	Longline	< 150 [C]	Gummy shark, school shark	Dynamic	All size boats together
Small pelagic state fisheries	-	Net, seine	< 250	Small pelagics, mackerel	Forced	All size boats together
Small pelagic Commonwealth fishery	-	Midwater trawl	< 300	Mackerel, red bait	Dynamic	All size boats together
Small pelagic purse seine	-	Purse seine	< 250	Small pelagics, mackerel	Forced	All size boats together
Squid jig	-	Jig	< 200	Squid	Forced	All size boats together
Tuna longline	-	Pelagic longline	> 50	Tuna and billfish	Forced	All size boats together
Tuna purse seine	-	Purse seine	> 50	Tuna and billfish	Forced	All size boats together

FISHERY (FLEET)	FLEET COMPONENT	GEAR	DEPTHS (M)	PRIMARY TARGET GROUP(S)	EFFORT MODEL	SUBFLEETS
Trawl (with state, SET and GABT divisions) [D]	Cephalopod trawl	Bottom trawl	< 300	Squid	Dynamic	All size boats together
	Crustacean trawl	Bottom trawl	50 – 250	Crustaceans [E]	Forced	All size boats together
	Prawn trawl	Bottom trawl	300 - 500	Royal red prawns	Dynamic	All size boats together
	Fin-fish midwater trawl	Midwater trawl	50-400	Demersals	Dynamic	All size boats together
	Squid midwater trawl	Midwater trawl	< 500	Squid	Dynamic	All size boats together
	Danish seine	Danish seine	< 200	Flathead	Dynamic	< 30m
						> 30m
	General demersal (slope) trawl [F]	Bottom trawl	< 650	Ling, blue grenadier	Dynamic	< 30m
						30 – 40m
						40 – 50m
						> 50 m
	Shelf demersal trawl	Bottom trawl	< 250	Flathead	Dynamic	< 30m
						30 – 40m
						> 40m
	Orange roughy trawl	Bottom trawl	< 1250	Orange roughy	Dynamic	< 30m
						30 – 40m
						> 40m

A. In reality auto-longline is between 183-600m, but the resolution of the model meant that it had to be represented as either 150-600 or 250-600. It was decided in this case to use 150-600, but in the future sensitivity to this decision (or better still resolving the model so it can represent say 180-600) needs to be considered – see discussion of the gillnet and auto-longline and shark catch results for further exploration of this topic.

B. This depth was set to capture historical catches and because of the vertical resolution of the model, more recently the majority of observed scallop dredging is in waters <80m.

C. This depth was set to capture historical catches and because of the vertical resolution of the model, since the adoption of quota management for gummy and school shark most observed effort is in waters <80m.

D. The state fishery components were really only active for Crustacean trawl and Shelf demersal trawl components.

E. For state fisheries the primary target groups are prawns and giant crab, while for the Commonwealth fisheries the target group is “non prawn crustaceans”.

F. While active on the upper slope this trawl fleet ranges more widely and can be found fishing the shelf break and on the shelf (changing its targeting appropriately).

The Atlantis-SEAP model has a total of 132 boxes. The spatial structure is divided into strips, which follow the coastline and separate the area based on water depth. These strips delineate the coastal zone (which extends to approximately the 50m isobath), the shelf zone (delimited by the 200m isobath) and the upper slope zone. These areas have been further subdivided latitudinally, to consider the pelagic provinces identified by the IMCRA pelagic bioregionalisation (IMCRA technical group, 1998), as well as the location of rivers and bays and the coastal morphology. As with Atlantis-SE a set of boundary boxes forms the oceanic edge of the model domain.

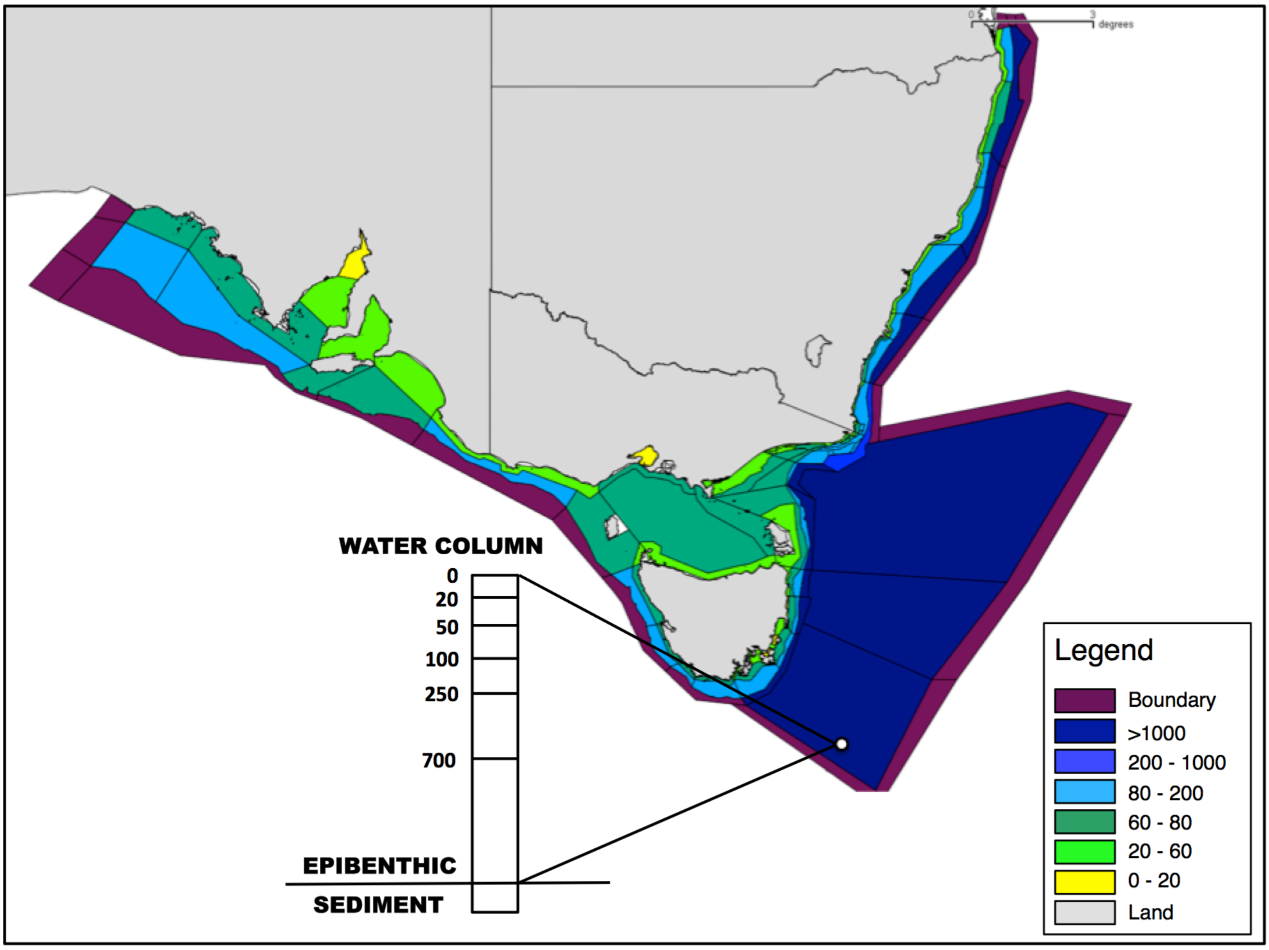


Figure 6: Map of the model domain for Atlantis-SEAP. Box colour denotes depth of box.

Ecological structure

The biology of Atlantis-SEAP is based on the Atlantis-SM model, with additional species and functional groups added to cover species that are of particular interest to managers in the system (particularly the state fisheries agencies). These additional species were either representative aquaculture groups or wild species identified as vulnerable in Pecl et al (2011). The later were typically recreational target species or of conservation concern. The complete list of trophic groups include in the model is provided in Table 3.

The diet connections between all biological groups in the model have been substantially revised to reflect more up to date information on diet and predator-prey interactions. The biological parameters for all groups were also updated in line with the latest information available, including: revised growth rates, physiological rates, initial abundances, spawning dates, habitat preferences and distributions where appropriate. Particular attention was put into size- and age-based representations of urchins, abalone and lobster – to better capture their size-based interactions and behaviour.

The updated and newly added groups include:

- Abalone
- Banded morwong
- Small pelagic fish
- Mesopelagic fish
- Gummy shark
- Large pelagic fish (which now includes marlin, at the request of state fisheries managers)
- Shallow piscivores (which now includes kingfish, at the request of state fisheries managers)
- Shallow demersal herbivores
- Sea urchins
- Southern rock lobster and eastern rock lobster (now separate rather than aggregated as "lobster")
- Pink snapper
- Tuna (parameterised as stripey tuna)
- Flatheads (separated from other shallow demersal fish)
- Arrow squid and southern calamari (now separate rather than aggregated as "Squid")

Table 3: Trophic groups included in the new Atlantis-SEAP model

GROUP NAME	GROUP COMPOSITION
Pelagic invertebrates & flora	
Large phytoplankton	Diatoms
Small phytoplankton	Picophytoplankton
Microzooplankton	Flagellates
Mesozooplankton	Copepods
Large zooplankton	Krill
Gelatinous zooplankton	
Pelagic bacteria	
Arrow squid	*Notodarus gouldi*
Southern calamari	*Sepioteuthis australis*
Benthic invertebrates & flora	
Macroalgae	Kelp
Seagrass	
Urchins	
Abalone	*Haliotis laevigata, Haliotis rubra*
Lobster	*Jasus edwardsii, Jasus verreauxi*
Benthic deposit feeders	Holothurians, echinoderms, burrowing bivalves
Benthic carnivores	Polychaetes
Deep benthic filter feeders	Sponges, corals, crinoids, bivalves
Shallow benthic filter feeders	Mussels, oysters, sponges, corals
Commercial crabs	
Prawns	
Macrozoobenthos	Stomatopods, octopus, asteroids, gastropods, crustaceans
Meiobenthos	
Benthic bacteria	
Aquaculture species	
Salmon	*Salmo salar*
Tuna	*Thunnus maccoyii*
Molluscs	Bivalves
Crustacea	*Penaeus monodon*

GROUP NAME	GROUP COMPOSITION
Fin-fish	
Small planktivores	*Sardinops sagax*, *Engraulis australis*, *Hyperlophus vittatus*, *Spratelloides robustus, Trachurus novaezelandiae, Argentina australiae*
Large planktivores	*Trachurus declivis*, *Scomber australasicus*, *Emmelichthys nitidus*, *Trachurus novaezelandiae*
Blue grenadier	*Macruronus novaezelandiae*
Oceanic planktivores	Exocoetidae, Scomberesocidae
Banded morwong	*Cheilodactylus spectabilis*
Shallow piscivores	*Arripis trutta, Thyrsites, Dinolestes lewini, Arripis georgianus, Pomatomus saltatrix, Sphyraena, Euthynnus affinis, Atractoscion aequidens, Sarda australis, Coryphaena hippurus, Argyosomus hololepidotus, Seriola lalandi*
Large piscivores	*Auxis thazard, Katsuwonus pelamis, Thunnus, Istiophoridae, Xiphias gladius,* billfish
Flatheads	Platycephalidae
Shallow demersal reef fish	*Trachinops caudimaculatus,* Labridae, Monacanthidae, *Atypichthys latus, Scorpis aequipinnis, Enoplosus armatus, Caesioperca lepidoptera, Pempheris multiradiata, Scorpis lineolata*
Myctophids	
Non-migratory mesopelagics	Sternophychids, cyclothene (lightfish)
Purple wrasse	*Pseudolabrus fucicola*
Deep demersal fish	Zeidae, Cyttidae, *Genypterus blacodes*, *Rexea solandri*, *Polyprion oxygeneios*, *Paraulopus nigripinnis*, *Rexea antefurcata*, *Coelorinchus*, Oreosomatidae, Macrouridae, Zenopsis, *Centroberyx*, cardinalfish, *Mora moro*
Shallow demersal fish	Paralichthyidae, Pleuronectidae, Triglidae, *Rhabdosargus sarba*, *Pseudophycis bachus*, *Lotella, Pseudophycis*, *Acanthopagrus butcheri*, *Pseudocaranax georgianus*, *Acanthopagrus australis*, *Sillago*, *Zeus faber*, *Helicolenus percoides*, *Hime purpurissatus*, Batrachoidiformes, *Nemadactylus*, *Sebastes alutus*, *Pterygotrigla*, Uranoscopidae, *Scolecenchelys breviceps*
Herring cale	*Odax cyanomelas*
Blue throat wrasse	*Notolabrus tetricus*
Pink snapper	*Pagrus auratus*
Shallow demersal herbivores	*Kyphosus sydneyanus*, *Girella elevata*, *Hyporhamphus melanochir*, *Girella tricuspidata*, *Dactylophora nigricans*, Aplodactylidae, Mugilidae
Warehous and trevalla	*Seriolella*, *Hyperoglyphe Antarctica*
Shallow territorial fish	*Hippocampus*, *Phycodurus eques, Phyllopteryx taeniolatus*, *Stigmatopora*, Gobiidae, Pomacentridae, *Monodactylus argenteus*
Magpie perch	*Cheilodactylus nigripes*
Sharks	
Demersal sharks	*Heterodontus portusjacksoni*, Scyliorhinidae, Orectolobidae
Spikey dogshark	*Squalus megalops*
Pelagic sharks	*Prionace glauca, Isurus oxyrunchus, Carcharodon carcharias, Carcharhinus*
Green-eye dogfish	*Centrophorus*
Gummy shark	*Mustelus antarcticus*
Skates and rays	Rajidae, Dasyatidae
Top predators	
Seabirds	Diomedeidae, *Puffinus*, Laridae, *Morus*, *Eudyptula minor*
Pinnipeds	*Arctocephalus pusillus doriferus, Arctocephalus forsteri*
Baleen whales	*Megaptera novaeangliae, Balaenoptera, Eubalaena australis*
Toothed whales	*Orcinus orca*
Dolphins	Delphinidae

Fisheries and Aquaculture

Patterns of effort per fleet (state fisheries, general small pelagics and general commercial trawl fisheries) were represented using a simple model based on catch-per-unit-effort (CPUE) thresholds, with days-at-sea by a fleet reduced if CPUE dropped below a lower threshold and days-at-sea increased if CPUE rose above an upper threshold. The thresholds used were based largely on catch rates from inshore shots of the Commonwealth trawl fisheries (from the AFMA logbook database) supplemented by catch rates from line fisheries in the region (based on personal communication) and state fishing records in Queensland and Western Australia. This use of data was necessary as sufficient official effort data was not available for the main state fisheries in the region of interest.

Aquaculture species were represented by stationary species that were seeded annually into specific locations (Figure 7) and feed a group specific daily ration (as required to achieve growth rates matching reported market sizes given the time in the water), except for molluscs, which were assumed to fed on plankton in their local environment. Salmon and tuna were only represented by age classes grown out in pens, while invertebrate groups were represented as biomass pools. In the case of the prawn aquaculture it is recognised that the pens are actually on land, but as the farms use marine water in their ponds they were treated as using ambient marine water so as to look at the potential effects of ocean acidification (on land bivalve aquaculture has already been impacted in this way on the west coast of the USA; Branch et al 2013). The level of production was taken from the Australian Fisheries Statistics time series released from ABARE (annual reports 1991 – 2012) and the location of aquaculture and timing of harvest was based on information sheets from the respective state departments. Two classes of site were identified: (i) primary production areas (populated at the beginning of each run) and (ii) potential alternative sites which could become active should production outstrip local resources at the primary sites or environmental conditions become unfavourable there. All waste from the aquaculture facilities was assumed to enter the normal detritus and nutrient pathways already in the model.

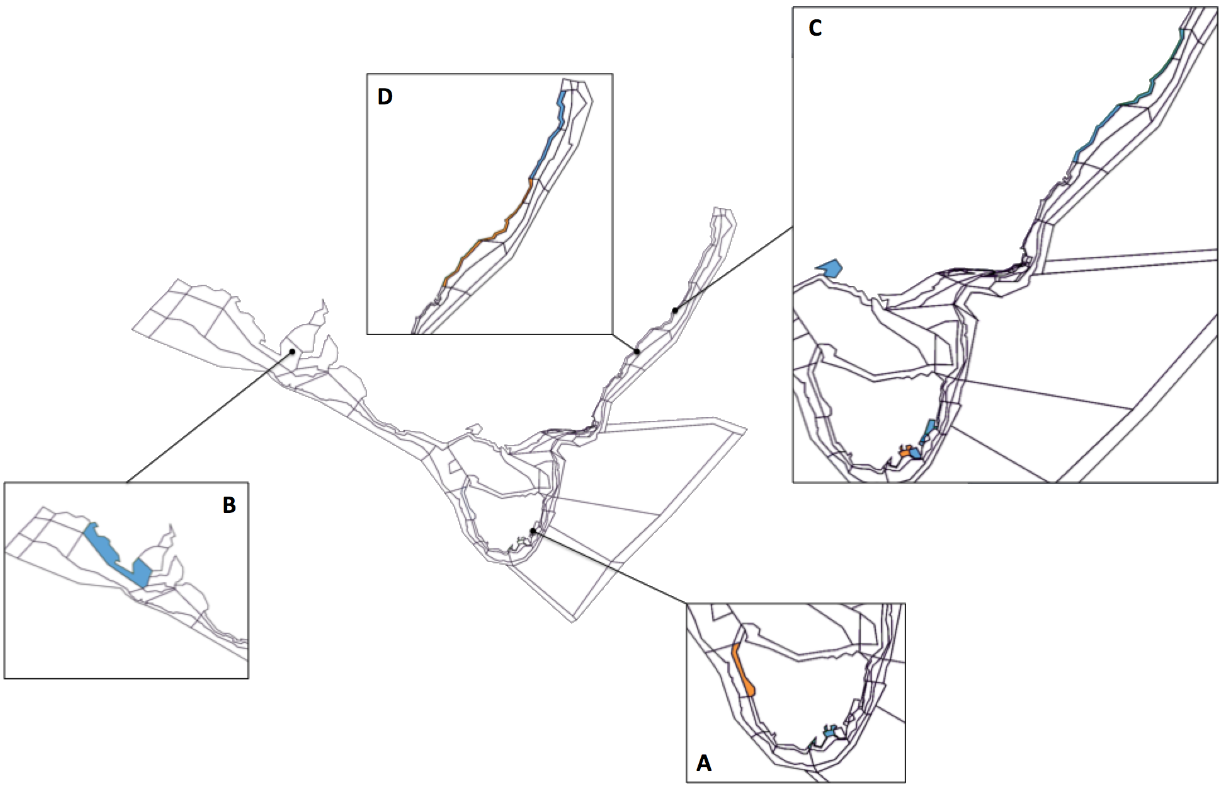


Figure 7: Location of aquaculture groups (sites) in Atlantis-SEAP (a) salmon, (b) southern bluefin tuna, (c) molluscs and (d) crustaceans. Blue cells represent primary production areas and orange are potential alternative sites.

Data for Atlantis Models

Data needs for Atlantis models are of many types. Essentially however, the basic requirements for each part of the model (physical environment, geomorphology, biological groups, fleets, markets) are starting levels, distributions, rate parameters and regulations or process information; preferably at as disaggregated a level as possible so that aggregations as close as possible to those used in the model can be calculated. Spatially referenced time series are particularly useful as many aspects can differ through space and time.

This level of data means the entire data inventory runs into many thousands (hundreds of thousands) of pieces of information (quantitative and qualitative) required for each model implemented. As a result the data used comes from many sources, including each of the state and federal fisheries authorities, federal departments (e.g. Department of Agriculture, Fisheries and Forestry and Department of the Environment), the Australian Bureau of Statistics (ABS), Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), CSIRO (especially for the climate drivers in the system), researchers working on the southeast region (including all those working within the broader SEAP Project, but also more broadly than that), industry members and literature. Drawing a specific schema incorporating all of these data sources individually is quite complicated (and unintelligible) so a more schematic-like schema is give here (Figure 8).

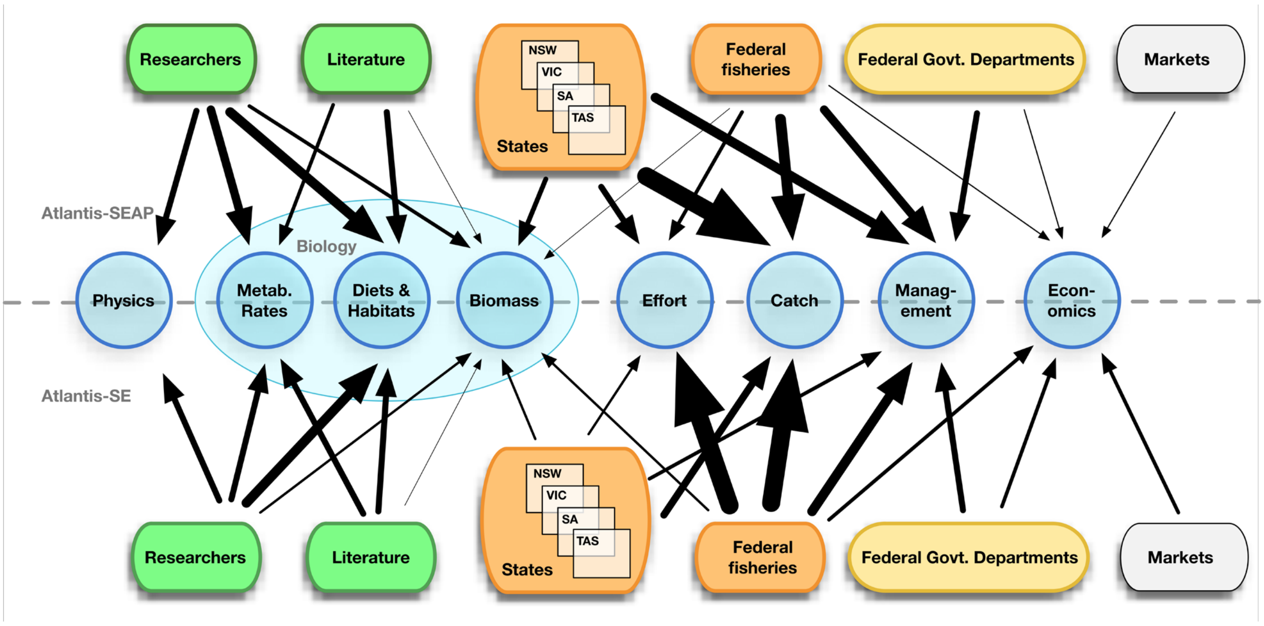


Figure 8: Schematic of how data sources feed into the Atlantis modelling components (with the state and federal fisheries boxes representing both the management agencies and representatives of the fisheries industries, the plot became too crowded if these were represented separately). The thickness of the arrows reflects the relative magnitude of data (or expert information) flows. The thickest arrows reflect where the most data pertinent to each model is available (e.g. Atlantis-SE state-based data use is smaller because it has an offshore focus so less state-based data is directly useful).

The initial (2000-2005) state of the Atlantis-SE was taken from a previously calibrated version of the model (see Fulton et al 2007) updated based on more recent survey data and information in Pecl et al (2011). The behaviour of the new model was then cross checked against more recent assessments (Morison et al 2012). The original Atlantis-SE biomass estimates came from surveys (Williams 1981, May and Blaber 1989, Chapman *et al* 1992, Young *et al* 1993, Smith *et al* 1995, Koslow 1996, Young *et al* 1996, Andrew *et al* 1997, Williams and Koslow 1997, Stevens and Wayte 1999, Bax and Williams 2000, Rowling 2000, Bax *et al* 2001, Bulman *et al* 2001, Williams and Bax 2001, Young *et al* 2001, Daley *et al* 2002, Graham 2005, Neira 2005, Walker *et* al 2005, Bulman *et al* 2006) and assessments (Tilzey 1994, Punt 2000, Punt *et al* 2000, Thomson 2002, Fay *et al* 2004, Smith and Wayte 2004, Taylor and Smith 2004, Tuck *et* al 2004, Tuck and Smith 2004, Klaer and Day 2006, Tuck 2006) and whether refined by iterative calibration of growth, clearance, non-predation mortality and trophic connection coefficients until the model predicted a plausible stable system under fished and unfished conditions. Similarly when the new data was added some minor modification (re-calibration) was required of the same parameters.

The trophic connections used in Atlantis-SE are based on diet information from data collected in the area (Coleman and Mobley 1984, Wingham 1985, Bulman and Blaber 1986, Skira 1986, Young and Blaber 1986, Blaber and Bulman 1987, May and Blaber 1989, Harris *et al* 1992, Jones and Morgan 1994, Young *et al* 1997, Cortes 1999, Norman and Reid 2000, Hedd and Gales 2001, Hedd *et al* 2001, Young and Davies 1992, Young *et al* 1993, Koslow 1996, Young *et al* 1996, Bulman *et al* 2001, Williams *et al* 2001, Young *et al* 2001, Bulman *et al* 2002, Chiaradia *et al* 2003, Bulman *et al* 2006), from consultation with experts on species in the area (Ross Daley, Dr John Stevens, Dr Cathy Bulman, Dr Jock Young, CSIRO Hobart) and from the literature (Kailola *et al* 1993, Prince 2001, Fishbase www.fishbase.org). These values all indicated where a connection existed and whether it was relatively strong or weak. The final availability scores used to make up Atlantis-SE’s diet connections were taken form these initial values and modified during calibration so that the resulting realised diet composition matched the available data and the biomass dynamics predicted by the model matched the best understanding of the changes in system state (from assessments and surveys). As mentioned above, an alternative diet structure which allows for a more changeable diet (based on the degree of flexibility observed in the North Sea and on Georges Bank over the last century; CEFAS and NOAA data sets) was constructed – to explore structural uncertainty in the models results associated with the food web connectivity.

For Atlantis-SEAP the main data sources used to define the initial biomass distributions for the various functional groups were: databases of the Central Ageing Facility, Fisheries Victoria; unpublished data (Fisheries Victoria, TAFI), the Fishbase database (www.fishbase.org); re-parameterisations of groups also in Atlantis-SM (Johnson et al. 2011), Atlantis-SE (Fulton et al. 2007) or Atlantis-NSW (Savina et al 2008); and relevant literature (e.g. Kuiter 1993, Gomon et al. 1994, Edgar 1997, Taylor and Willis 1998, Edgar and Barrett 1999, Greely et al 1999, Ewing et al 2003, Edgar et al 2004, Lyle et al 2004, Barrett et al 2007). Information from Pecl et al (2011) was used to further update any biological groups referenced in that report (in terms of biomass and initial distributions, revised growth rates, spawning times, life history characteristics or environmental preferences, tolerances or sensitivities). The model was then calibrated in the same way as for Atlantis-SE.

The trophic connections in Atlantis-SEAP were based on details in Johnson et al. (2011), Fulton et al. (2007) and other published information (e.g. O'Sullivan and Cullen 1983, Gales et al 1993, Kuiter 1993, Gales and Pemberton 1994, Smale 1996, Edgar 1997, Bulman et al 2001, Uchikawa et al 2002, Bulman et al 2002, Hume et al 2004). This initial matrix was supplemented by data on diet flexibility from CEFAS data set). The final quantitative availability terms were again achieved by taking the initial connections and refining them through calibration so that the resulting diets matched any available observations.

Representing the physical environment

For both Atlantis models vertical and horizontal exchanges between boxes were calculated from archived current velocities generated by the global ocean model OFAM (Oke et al 2005), which had a spatial resolution of 0.1° over the box model domain. Two separate OFAM archives were used, one is a reanalysis based on observational data (i.e. the Bluelink data-assimilated version based on data from 1994-2009; http://www.bom.gov.au/bluelink/ and SPINUP6 from http://www.marine.csiro.au/ofam1/) and a 2064 run on the OFAM model. Water column properties such as temperature and salinity are also taken from OFAM (e.g. 2064 temperatures in Figure 9), to insure consistency with the flows. A smooth interpolation was used to link the 2009 conditions with the 2064, with the offshore currents and boundary conditions conditioned on the output of the CSIRO’s global circulation model.

These flows and water properties were then extended through time to make continuous time series using output from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Mk 3.5 climate system model (Gordon et al 2010) derived from the Intergovernmental Panel on Climate Change (IPCC) Special Report Emissions Scenario (SRES) A2 scenario (IPCC 2007) and the ACCESS CMIP5 simulations (Collier and Uhe 2012) – which explicitly handed two of the "Representative Concentration Pathways” now

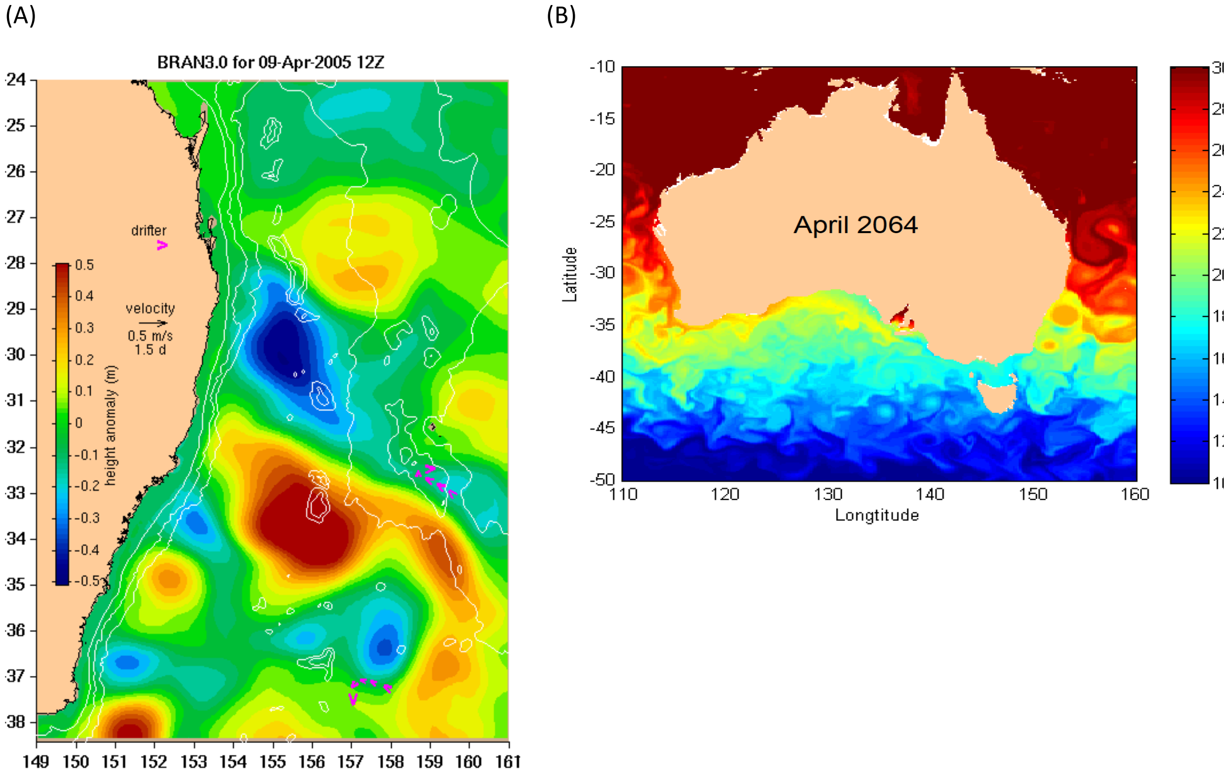


Figure 9: Example OFAM ocean output: (A) sea surface height (highlighting eddy locations) for April 9th 2005 (with data assimilation) and (B) sea surface temperatures in April 2064

used as standard scenarios by the IPCC. ACCESS coupled atmosphere-ocean simulations exist for RCP 4.5 and 8.5 (Collie and Uhe 2012), where RCP 8.5 is roughly equivalent to the A2 ("business as usual") scenario and RCP 4.5 represents a mid-range emission scenario. The final emissions scenario considered in this study was RCP 2.6 (which represents the lower end of emissions). As no Australia specific ocean-atmosphere down-scaling was available for this scenario it was constructed by interpolating between the current state and the RCP 4.5 dynamics to get gross patterns of flows (i.e. flows that have not changed as much as for RCP 4.5) and the final temperature and salinity trends were then conditioned on the RCP 2.6 outcomes of a global ensemble of models (Knutti and Sedlácek 2013). Thus ocean warming trends were incorporated into the existing oceanography to create a "reconstructed" regional temperature and salinity time series from 2000 through 2070. This reconstructed time series was validated from field measurements taken off the southeastern Australian coast from 2000 through 2010. Only three emission scenarios were selected to keep the number of simulations tractable, however these do span the range of currently accepted emissions scenarios and they show differentiation in atmospheric pCO2 levels (and thus expected temperature and acidification effects) by 2070 (Figure 10).

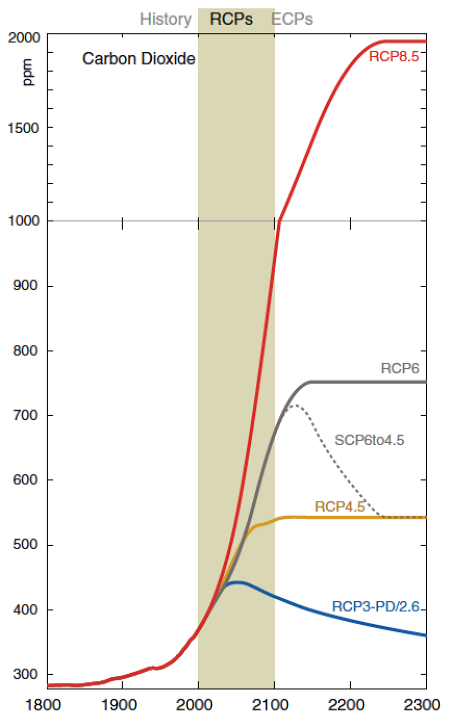


Figure 10: Atmospheric carbon content in the RCP scenarios (form Meinshausen et al 2011)

The individual exchanges were calculated by integrating the daily normal component of currents over each depth band of each box face (using realistic bathymetry to ensure face sectional areas are accurate). To account for the non-uniform nature of the box structure, exchanges were corrected for hyper diffusion within boxes. As a first approximation, the east-west exchanges were divided by the longitudinal scale of the box and north-south exchanges were divided by the latitudinal scale of the box. A conservative tracer was then used to check flows through the system, with tuned box-specific flow scalars used to remove any remaining hyper diffusion effects (this approach was used as it is much more tractable than inverse modelling over such large and complex domains).

Storm events were represented via simple impact models, where damage was applied to appropriate model components sitting under the footprint of the storm in proportion to the storm's intensity. Sea-level rise was also treated simply – via gradual changes in vertical layer depths and associated rates of sedimentation and inundation; with implicit representation of mechanisms to allow for the shoreward retreat of coastal habitats were suitable substrates existed. These processes were parameterised from the literature (Harmlien-Vivien and Laboute 1986, Ellison and Stoddart 1991, Dollar and Tribble 1993, French 1993, Michener et al 1997, Short and Neckles 1999, Reed 2002, Scavia et al 2002, Nicholls 2002, McInnes et al 2003, Williams et al 2003, Crooks 2004, Fourqurean and Rutten 2004, Nicholls 2004, Nicholls and Lowe 2004, Zhang et al 2004, Cruz-Palaciosa and van Tussenbroek 2005, Gardener et al 2005, Feagin et al 2005, Church et al 2006, Ericson et al 2006, Harley et al 2006) and conversations with regional geomorphology experts. All of these changes (summarised in Table 4) then formed the basis of the abiotic environment that was acted on by the dynamic Atlantis components.

Table 4: Summary of abiotic and global economic conditions used to set the broad context, and drive, the end-to-end models (global state taken from IPCC scenario definitions, IPCC 2013).

GLOBAL SYSTEM FEATURE	VALUE IN 2050 – RCP 8.5	VALUE IN 2050 – RCP 4.5	VALUE IN 2050 – RCP 2.6
Global properties			
Global GDP	140 ($US[*] 1000 billion yr^{-1})	110 ($US[*] 1000 billion yr^{-1})	150 ($US[*] 1000 billion yr^{-1})
Global population	9 (billion)	8.5 (billion)	8.5 (billion)
Economic development	Moderate (slow improvement in efficiency)	C price limits emissions	Moderate to rapid development & increasing efficiency & mitigation
CO_2 concentration	630 (ppm)	527 (ppm)	455 (ppm)
Global temperature change	+ 1.4-2.6 (°C)	+ 0.9-2.0 (°C)	+ 0.4-1.6 (°C)
Global sea-level rise	0.22-0.38 (m)	0.19-0.33 (m)	0.17-0.32 (m)
Global precipitation	-2-+7%	-1-+5%	-4-+4%
Global ocean pH	7.5 – 7.9	7.99 – 8.02	8.04 – 8.05
Australian properties			
Sea surface temperature change	+0.8-4.0 (°C)	+0.25-1.75 (°C)	+0.05-1.15 (°C)
pH change	-0.24 - -0.29	-0.08 – -0.05	-0.05 – -0.03
Storm frequency and intensity	Average intensity increases	Average intensity increases slightly	Little change in frequency or intensity
Precipitation	Up to 20% decrease across most of Australia, 30+% decrease in the southwest and 20+% increase in N-NW	Less than 20% decrease across most of Australia (slight increase possible especially in N-NW)	Less than 10% decrease across most of Australia (slight increase Australia wide also possible)

[a.] This is 1990 USD.

The final abiotic change represented was ocean acidification. This was done by forcing the atmospheric pCO_2 using the appropriate CMIP 5 emissions time series (available from the RCP database at http://tntcat.iiasa.ac.at:8787/RcpDb), equating to 440-860ppm pCO2 across the scenarios, and the using that to calculate ocean alkalinity using the regression equation of Bostock et al (2013) and standard chemical relationships from IAEA (Chemistry of Carbonic Acid in Water 2003, available at http://wwwnaweb.iaea.org/napc/ih/documents/global_cycle/vol%20I/cht_i_09.pdf) to calculate pH. Finally aragonite saturation was calculated using the relationship from Kleypas et al (2006). The impact of ocean acidification was then taken from the literature[2]. Few of Australia's species have been directly considered in acidification experiments so general response forms were calculated based on species level data (if available), sister taxa or species form the same taxonomic group in similar environmental conditions (often from the North Atlantic). The major ways in which ocean acidification could impact on a group were via its general growth, assimilation efficiency, nutritional value (to its predators), fecundity, movement and spatial distribution. Moreover there were many functional forms for the relationship – see Figure 11 for example relationships and Table 5 for a full summary of included effects.

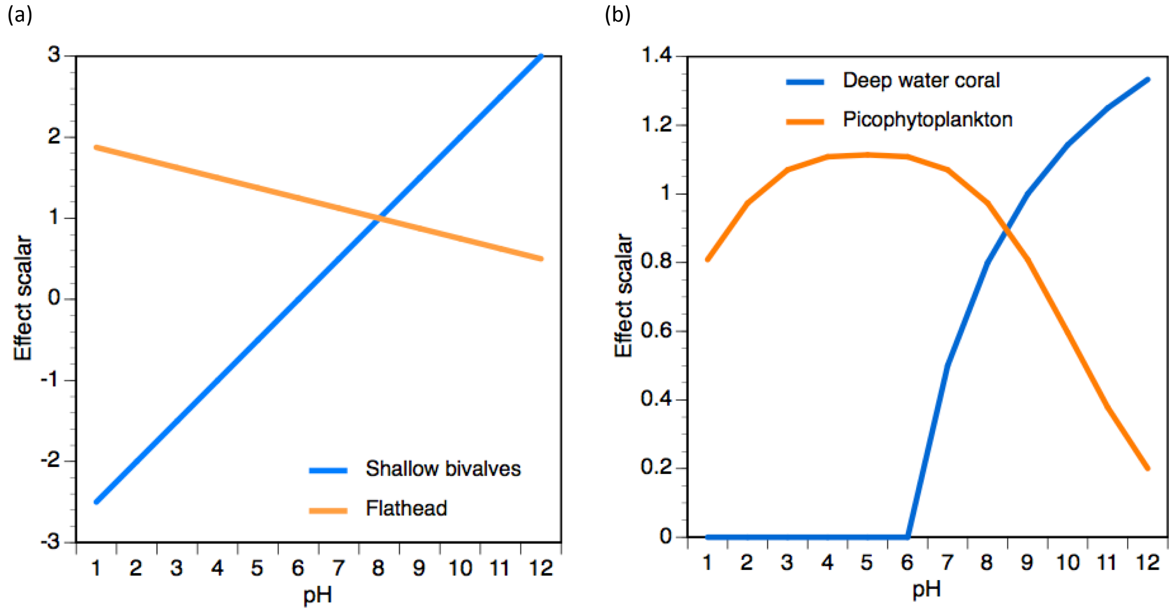


Figure 11: Example effects scalar for representing ocean acidification, temperature and salinity effects on functional group processes.

Table 5: Each acidification related entry indicates the shape of the response and whether it increases (+) or decreases (-) as pH lowers; for the nonlinear responses the point of the peak (whether at lower or higher pH) is also indicated. Distributions are constrained by temperature and salinity and for the physiological effects T stands for temperature affected and S for salinity.

	Acidification effects						Temperature and salinity effects		
GROUP TYPE	Thermal tolerance contraction	Nutritional value	Availability to predators	Growth & mortality rates	Fecundity	Other acidification effects	Physiology	Distribution constrained	Assimilation efficiency
Bacteria						Denitrification Linear (-)	T	No	
Phytoplankton		Nonlinear		Nonlinear			T, S	No	

[2] Given the extensive nature of the meta-analysis used, instead of overwhelming the text of this report the database of papers is available from Beth Fulton on request.

	Acidification effects						Temperature and salinity effects		
GROUP TYPE	Thermal tolerance contraction	Nutritional value	Availability to predators	Growth & mortality rates	Fecundity	Other acidification effects	Physiology	Distribution constrained	Assimilation efficiency
Microzooplankton							T, S	No	
Meso- and Macro-zooplankton				Monod (-)			T	No	
Jellyfish							T	No	
Cephalopods	Monod (-)			Monod (-)			T	Yes	
Kelp		Nonlinear		Nonlinear (peak at higher)			T	Yes	
Seagrass		Nonlinear		Nonlinear (peak at lower)			T	No	
Meiofauna							T	No	
Polychaetes							T	No	
Bivalves				Linear (-)			T	Some	
Deep water corals				Monod (-)			T, S	Yes	
Crustaceans				Monod (-)	Monod (-)		T	Yes	
Echinoderms				Linear (-)			T	Yes	
Forage fish	Linear (+)						T	Yes	
Demersal fish	Linear (+)		Linear (+)				T	Yes	Warmer (-)
Large piscivores	Linear (+)			Linear (-)			T	Yes	Cooler (-)
Dogfish	Linear (+)			Linear (-)			T	Yes	Warmer (-)
Other sharks	Linear (+)						T	Yes	
Rays	Linear (+)						T	Yes	
Mammals							T	Yes	
Seabirds							T	Yes	

Representing change in the human systems

The large contribution of exports to the Australian economy (and the way in which export markets support many Australian industries) means that the general form of the global economy is needed as a model driver, which is why global RCP scenarios were chosen to provide the broad abiotic and economic context. Social and economic changes related to the fishing and aquaculture industries activities are derived from dynamic and quite detailed sector and regulatory models. The activities of other sectors represented via an impact model (which are discussed further under the cumulative change scenario below). This impact model was made more responsive (i.e. more dynamic than a fixed constant or linearly changing level of impact) via coupling it with a dynamic stocks-and-flows representation of coastal sectors to determine the magnitude of potential impacts (primarily in the form of changed flows from estuaries, including the magnitude and seasonal patterns of river flow, but also pollutant content and salinity levels; levels of outflows of dissolved nutrients from catchments or outfalls; and substrate available for coastal habitats). This simple economics-based representation of coastal industries is a modified form of the relevant industries in Engelen et al (1997), Fulton et al (2011), White et al (2000) and Waddell et al (2003) and the representation of technological shifts and inter-industry structures is based on Pant (2007). The final impact model allows for shifting demography, effects on available labour sources and demands on services, innovation and technological uptake (changing costs, prices and efficiencies) and shifts in infrastructure (capacity, costs and maintenance). In all of these representations a temperature-dependent damage function was used to link the biophysical and human spheres, but with explicit feedbacks for fish production, coastal habitats, nutrient cycling, the status of charismatic species and general habitability. A fully dynamic approach was initially taken (e.g. simulations published in Fulton 2011), but this was computationally quite expensive so for subsequent simulations the outputs of the system models used by Fulton (2011) were used as the basis of a multi-faceted impacts model that became the basis of the cumulative change scenario used in here.

Cumulative effects of physical drivers & fisheries management

During this projection period all of the ecological and socio-economic components were able to react dynamically to their circumstances. Each simulation was run for a decade to remove any transitory dynamics due to the initial starting conditions, this was information was discarded and on the trajectories for 2010 through to 2070 were included in any analyses. This end date was arbitrary but reflects a point where there was sufficient differentiation between the physical state of the system under the different RCP scenarios. In addition the version of the model that did not allow for acclimation (discussed in more detail below) often became numerically unstable around and beyond this point due to the inability of the static parameterisation deal with the changed physical state.

The interacting effects of temperature change, acidification and fisheries were considered using the additive model and Hedge's D method by Griffith et al (2011, 2012), which calculates the individual, main (net) and interaction effect sizes for each scenario. This approach was used as it identifies whether the different stressors act antagonistically, additively or synergistically; it is more conservative in terms of quantifying the negative effect of multiple stressors (Crain et al 2008, Sih et al 1998); has previously been successfully applied to investigating cumulative stressor impacts in the marine environment (Crain et al 2008, Folt et al 1999); and may be more appropriate when stressors affect different physiological processes and trophic levels (Gurevich et al 2000).

Evolution and acclimation

Early simulations made it clear that dynamic parameterisations representing acclimation and adaptation was necessary for creating plausible, realistic and more reliable projections of the alternative futures. Within the ecological components of the models three approaches were used to capturing biological adaptation:

I) **Spatial shifts based on tolerated environmental conditions** – the standard seasonal, forage and density dependent movement formulations are set to zero if conditions are outside tolerated bounds for the group (i.e. spatial distribution is limited and shifts are based on temperature, salinity and oxygen levels).

II) **Acclimation** – the parameters slowly shift over time, with the optimal environmental conditions continually slowly shifting toward the experienced environmental state using the following equation:

$$O_{t+1} = O_t + \left(O_t - E_{t+1}\right) \cdot \lambda$$

where O_t is the optimal environmental state for the group at time t, E_t is the environmental state at time t and λ is the rate of shift in optima expressed by the group. The rate of shift was taken from the literature, but was highest at 0.25 for phytoplankton down to 0.01 for top predators (equating to a roughly 5% change over 50 years).

III) **Evolution & biodiviersity shifts** – where multiple expressions of each trait are kept (e.g. multiple genotypes with different growth, consumption, assimilation efficiency and tolerance levels per group) and surviving individuals reproduce (with inheritance and small rates of mutation), leading to a potential shift in mean parameterisation. This was based on Jones et al (2003), Dunlop et al (2007, 2009), Wang and Hook (2009). This formulation represents evolution in single species groups, but turn over in the composition of aggregate functional groups.

The dynamics of the human models did not have the same degree of morphing within the parameterisation. Instead it was assumed the psychological factors already incorporated in the effort allocation models already captured the operator's capacity for adaptation on short to medium time scales.

SE Management Strategies

During a series of workshops (held in 2011-2013) stakeholders defined a long list of alternative development, economic, climate and ecological scenarios, as well as the key governance and industry behavioural strategies of interest. These different scenarios and strategies were then combined to define the conditions under which each simulation was run. It was clear from the workshops that the desire was to focus on management strategies were biological sustainability and economic profitability remained key objectives. As the dynamics of international markets were beyond the scope of these simulations economic conditions from ABS projections or similar to those experienced today were retained through each simulation with management adjustments based on biomass reference points. The resulting catch and costs were recorded so that the status could be meaningfully compared to today's state without being lost in the vagaries of international exchange rates etc.

It was important that the scenarios and strategies were defined via a consultative process so that the strategies were relevant to existing concerns and ideas and so that anyone interested in the system could understand its potential responses to proposed actions and their associated trade-offs. To facilitate the consultative process a structured approach was taken to the workshops:

1. An overview of uncertainty and system dynamics was presented along with a demonstration of the non-intuitive nature of complex systems, how little the human brain is prepared for system dynamics and how models can help teach the brain new means of coping, understanding and anticipating system change.
2. An overview of the latest knowledge on climate change and its effect on marine environment was presented.
3. Stakeholders were divided into mixed teams of 2-5 made up of industry representatives, scientists and managers. These teams then sketched out the details of the scenarios and strategies (including a brief description of what should be modelled and the thinking behind the proposition). If it appeared that the scenarios/strategies were really only minor variations on a theme, the workshop facilitators would ask about more "outside the box" options (e.g. extreme climate change

outcomes in hotspot locations, large scale habitat modification as done in Asia, stock enhancements). There was no pressure on workshop participants to actually use those "what-if" suggestions; they were there merely as a stimulus to ensure thinking was not constrained only to what the present state of the system looks like (which is a danger in scenario definition exercises).

4. After each workshop the breadth of the scenarios defined were compared with generic scenarios drawn up by focus groups held in Hobart, Melbourne, Canberra and Exmouth as part of a visioning exercise for Australia in 2050. While the focus of those scenarios tended to be more socially and culturally focused, they did not possibilities or management objectives not already covered in the stakeholder defined scenarios.

A complete set of scenarios is given in Table 6 and more detailed descriptions of each scenario are given below.

GOVERNANCE STRATEGIES

Cross border management

This strategy sees different management options applied on either side of jurisdictional boundaries – both between states, but also between state waters and those under federal (AFMA) jurisdiction. The first form of this scenario basically reflects the current (as of 2010) and historical fisheries management arrangements where management was often independently done by zone and state (Figure 12a). The second has only two jurisdictions – inshore and offshore, to represent a "combined states" versus "national" (federal) jurisdictional split (Figure 12b). Species of particular focus in this case where demersal fish like flathead, blue grenadier, blue-eye trevalla and gummy shark. In addition, some species have multiple genetic stocks (e.g. east and west), which are not always reflected in management zones – the different stocks of orange roughy, ling and blue warehou are acknowledged, but this is not the case for other species in the model.

In the case of Atlantis-SEAP the inshore-offshore split was not considered in as much depth (as the offshore portion of the region is not represented in as much detail) and the focus was placed on consideration of individual state-level management or negotiated allocation across state borders.

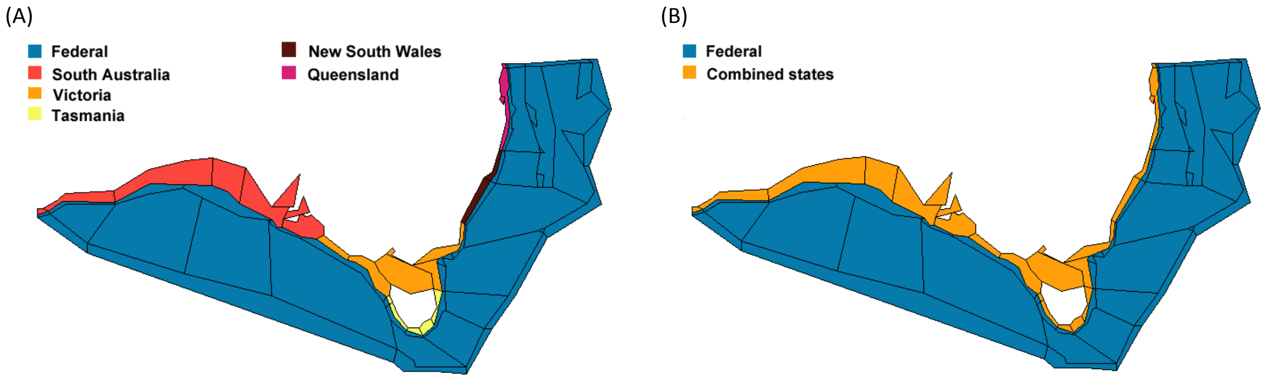


Figure 12: Map of different jurisdictions in the cross border management scenarios with (A) separate states and AFMA jurisdictions, (B) only two jurisdictions (inshore and offshore)

Centralised management

A single management body has jurisdiction for all stocks (rather than the multiple management agencies that act across the region today). All target species are assumed under quota management, with the quotas set equal to existing quotas or total catch limits.

Table 6: Scenarios and strategies defined for the Atlantis-based SEAP project (these were applied using Atlantis-SEAP and Atlantis-SE). Note that Y = yes, N = No, M = maybe or might need to be "painted in" or "forced" rather than fully dynamic.

NAME	SUMMARY	ATLANTIS-SE	ATLANTIS-SEAP
Governance[1]			
Cross border management	Apply different management options on either side of jurisdictional boundary (i.e. base case of current management where management done differently by zone and state)	Y	Y
Centralised management	A single management body has responsibility for the stocks rather than multiple management agencies across the region	Y	Y
Spatial management	Different sized spatial closures (10%, 30%,75% both smeared and in chunks); also temporal vs spatial closures; and static vs mobile closures (that shift with conditions)	Y	Y
Off reserve management	Spatial management as well as other forms of management[2]		
Input vs Output	Uncertainty associated with input vs output vs mixed (& which most robust)?	Y	Y
Fisheries enhancement	Interventions to enhance stock performance (stocking, moving individuals to more productive locations etc); compare onshore, caged, ranching etc.	Y	M
New species or fisheries	Dealing with "new" species that becomes commercially viable	M	Y
Recovery	Dealing with delisting and renewing fishing once recovered[3]	M	M
Management delay	Stock capacity shifts (up or down), but reference points remain unchanged	Y	Y
Monitoring schemes	Alternative monitoring schemes (per state vs integrated)	Y	M
Fisher behaviour			
Changing compliance behaviour		Y	Y
Increasing recreational fishing pressure	Due to rising human population, increased affluence (or conversely subsistence needs) and new "attractive trophy" species see increase in recreational and charter fishing. Not only increased magnitude but location (offshore pelagic and further south)	Y	Y
Differential exploration	Different types of fisher show differing degrees of exploration and modification of effort allocation patterns (spatially and when new species becomes commercially viable)	M	Y
Myctophid fishery	For aquaculture feed[4]	N	Y
Other new fisheries	Myctophids, jellyfish, krill, microfauna (for biofuels), kelp		
Technology creep	Fishers becoming more efficient	Y	Y
Universally increasing demand	Effort (demand) for all sectors increases (export demand, reduced imports, increased recreational fishing pressure)	Y	Y
Gear swicthing	Gear used up to fisher once have quota (or as a result of shifting export demands regarding what is targeted, its size, quality etc)	M	Y
Aquaculture practices	Changed stocking density	Y	N
Economic			
Changed markets	Either through marketing or changing consumer preferences see shift in demand (e.g. immigrant families make a push	Y	Y

NAME	SUMMARY	ATLANTIS-SE	ATLANTIS-SEAP
	away from simply white flesh finfish, or shift in export markets)		
Changed costs	Shifting cost structure (e.g. increased costs); Carbon tax implications for commercial and recreational fisheries); including disruption of access to some ports as access changes	M	Y
Aquaculture viability	Changing costs and returns see aquaculture cease to be viable in some locations[5]	M	M
Physical climate effects			
Changed conditions effecting production	Stratification, turbidity, eddy strength or location, changed upwellings, hypoxia	Y	Y
Major event	Major climatic event (e.g. extreme El Nino); perhaps also with changing frequency	Y	Y
Gradual change	By default will assume climate happens in smooth "linear" gradual change	Y	Y
Step changes	Climate changes happen in bursts (stay in one pattern for a decade then step change in 1 year to the next pattern and so on until reach 2064 state)	Y	Y
Ecological			
Range shifting species	Species moving into system as result of shifting climate (including new predators moving south)	Y	Y
Introduced species	Pest species introduced by aquaculture or ballast	Y	Y
Disease outbreak	Epidemic across region ("catastrophic event"); perhaps with changing prevalence with changing conditions	Y	Y
Increased variability	Sudden shifts in stock status or system (plankton blooms, recruitment failure, habitat collapse)	M	M
Changed recruitment	Estuarine recruitment tied to river flow, or coastal habitat etc, which changes through time	Y	M
Other			
Changed land use	Impacts of land and catchment use (e.g. nutrients, run-off, sediments, dredging, land reclamation along coast)	Y	Y
Other offshore industries	Mining, oil-n-gas, shipping etc (closures, other impacts like seismic shocks, spills, noise etc)	Y	Y
Not possible – as yet	*Maybe possible with model development or in consultation with experts*		
Competition between markets	Competition between aquaculture and human consumption for wild caught fish	N	M
Concentration of ownership	Concentration of quota ownership so small operators lost	N	M

1. Some of these are applied simultaneously across all stocks, but as a minimum they will be applied to the current target species keeping everything else at "Status Quo" (as of 2010). In addition the SEAP focus species and bycatch and TEP species will be given special focus as they are of most interest to the broader stakeholder community.
2. These can also have off reserve management – at the present "Status Quo" (as of 2010) is assumed to hold throughout.
3. These require further direction from managers on anticipated steps (still waiting on this feedback, but it maybe a triage hierarchy)
4. Only possible for the offshore model, as myctophids are not a focus group in in the inshore model.
5. This still required further model refinement, but it should be possible to experiment with this a bit, though some of the aspects this need to be forced by physical effects on productivity (and other aspects are beyond what Atlantis can resolve spatially, as its not at a fine enough spatial scale

Spatial and temporal management

This comprises a set of 10 strategies. The first are seasonal closures, which run from July to December, in combination with spawning closures for target species. All spatial management has been removed in this case. The rest of these strategies revolve around different sized spatial closures (10%, 30% and 75%). These closures are implemented in two ways: either as large contiguous closures (Figure 13) or as small closures smeared across the entire region (e.g. if there is a 10% closure then 10% of the fishable area of each spatial box will be closed to fishing). These closures are simultaneously applied to all fleets (gear types and vessels sizes) in the region.

Mobile closures (that shift with environmental conditions, such as fronts and temperature contours) were also implemented so that the core of the distribution of each stock was protected at all times. This was done by finding the proportion of biomass in each box per stock and closing targeted fishing in the three boxes with the highest proportional biomasses.

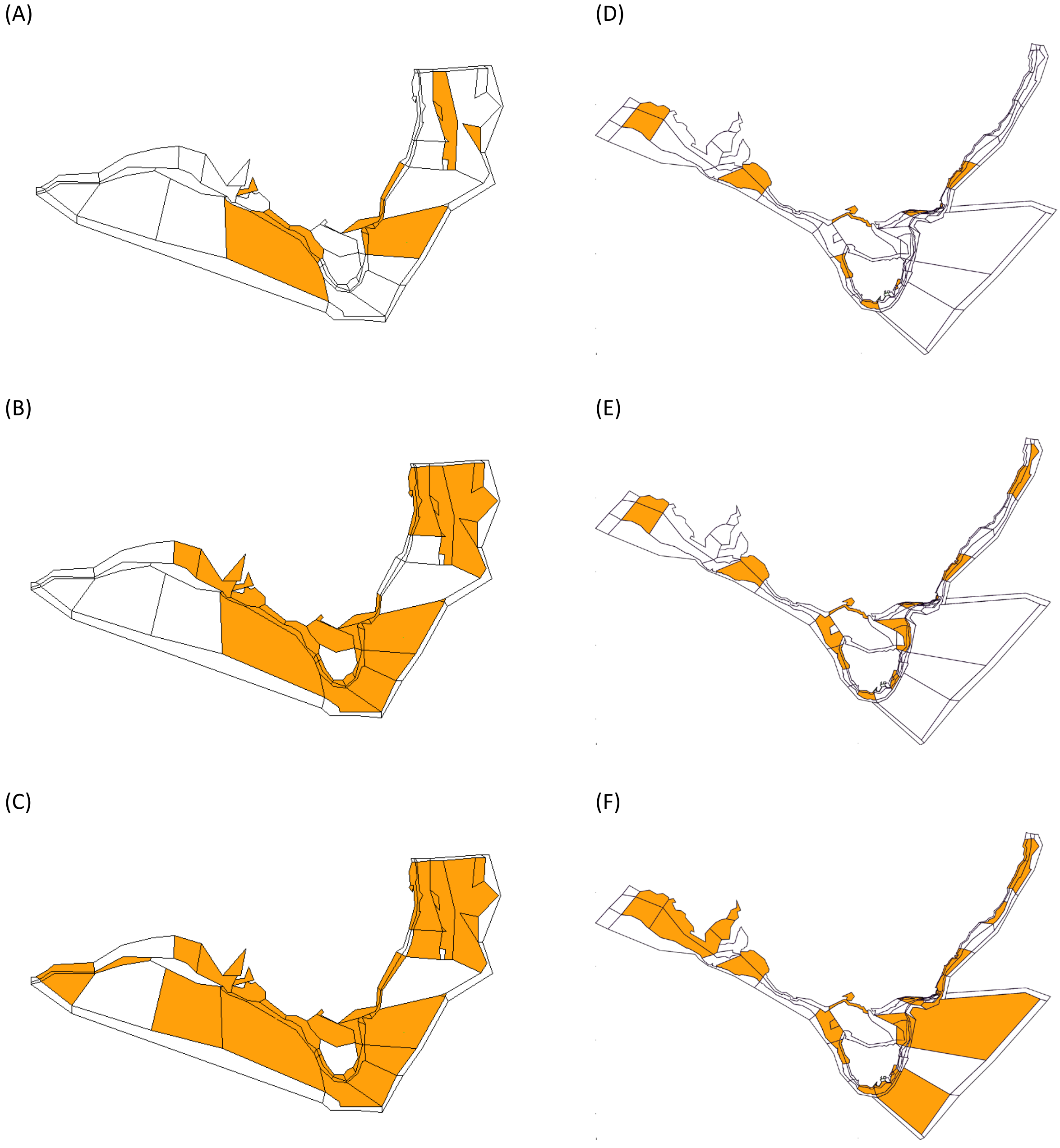


Figure 13: Spatial arrangement of the large contiguous spatial closures (closures marked in orange): (A)-(C) for Atlantis-SE and (D)-(F) for Atlantis-SEAP. (A & D) 10% closure, (B & E) 30% closure and (C & F) 70% closure.

Off reserve management

This form of management includes all forms of management levers – gear limitations, spatial management, quota management etc. The status quo management in place in 2010 in the Commonwealth jurisdiction already included all of these facets and the state-based management also included many of the levers. Consequently the AFMA management regulations were used as a basis for expanding the state based management to include all aspects of off reserve management.

Input CAPS

There was a lot of interest expressed in the difference (and uncertainty associated with) input versus output vs mixed management approaches. As many of the other strategies included output controls and gear limitations, this strategy capped effort per year per fleet (defined based on vessel size and gear type) at 2010 levels.

Fisheries enhancement

This form of management is inspired by the large-scale ecosystem-level interventions seen in Asian nations, like Japan. The scenario includes the use of technological fixes aimed at enhancing stock performance and can include stocking (including onshore hatcheries or wild capture of juveniles), movement of individuals to more productive locations, caged and ranching aquaculture. Essentially any form of management that identifies weak points in the life history of target species and intervenes with technology or animal husbandry to bolster production. The steps needed in such scenarios were much easier to envisage and define for inshore species (e.g. lobster) and as a result this scenario was only used with Atlantis-SEAP.

New species or fisheries

This deals with “new” species that become commercially viable in the region. This was done in two ways: (i) via a range extension of a tuna species or a shallow demersal fish species which became a fisheries target (commercial and/or recreational) managed in the same way as for other target species; and (ii) where intentional over exploitation is used to minimise the impact of pestilent range extending species. The biological details for range extending species are provided below.

Recovery

This strategy deals with conservation driven management actions, such as species listing, recovery and delisting. While there are no clear formal directions on how a species is delisted it was assumed here that once a species had reached > 30% of unfished (unimpacted) levels it could again be handled under fisheries management rules rather than being prohibited under conservation rules.

Management delay

This management strategy uses status quo (as of 2010) levers and reference points (i.e. harvest control rules currently applied in the SESSF in 2010, available from AFMA), but with management responses slowed so that assessments (and resulting modifications to quotas and other management measures) occur only every 5 years instead of annually.

Monitoring schemes

This strategy is to trial alternative monitoring schemes (e.g. per state vs integrated across all spatial areas). This is a natural counterpart to the strategies discussed above where management is either done per jurisdiction or by an overarching management group. Two sets of sites were monitored (Figure 14), which reflect either low level coverage (typical of monitoring to date) or a more comprehensive coverage. These sampling schemes were based on those explored in Smith et al (2011b).

This information was then either split into reports per state with state-based assessments only based on information from state waters, or the entire set was fed into the centralised assessments.

(A) (B)

(C) (D)

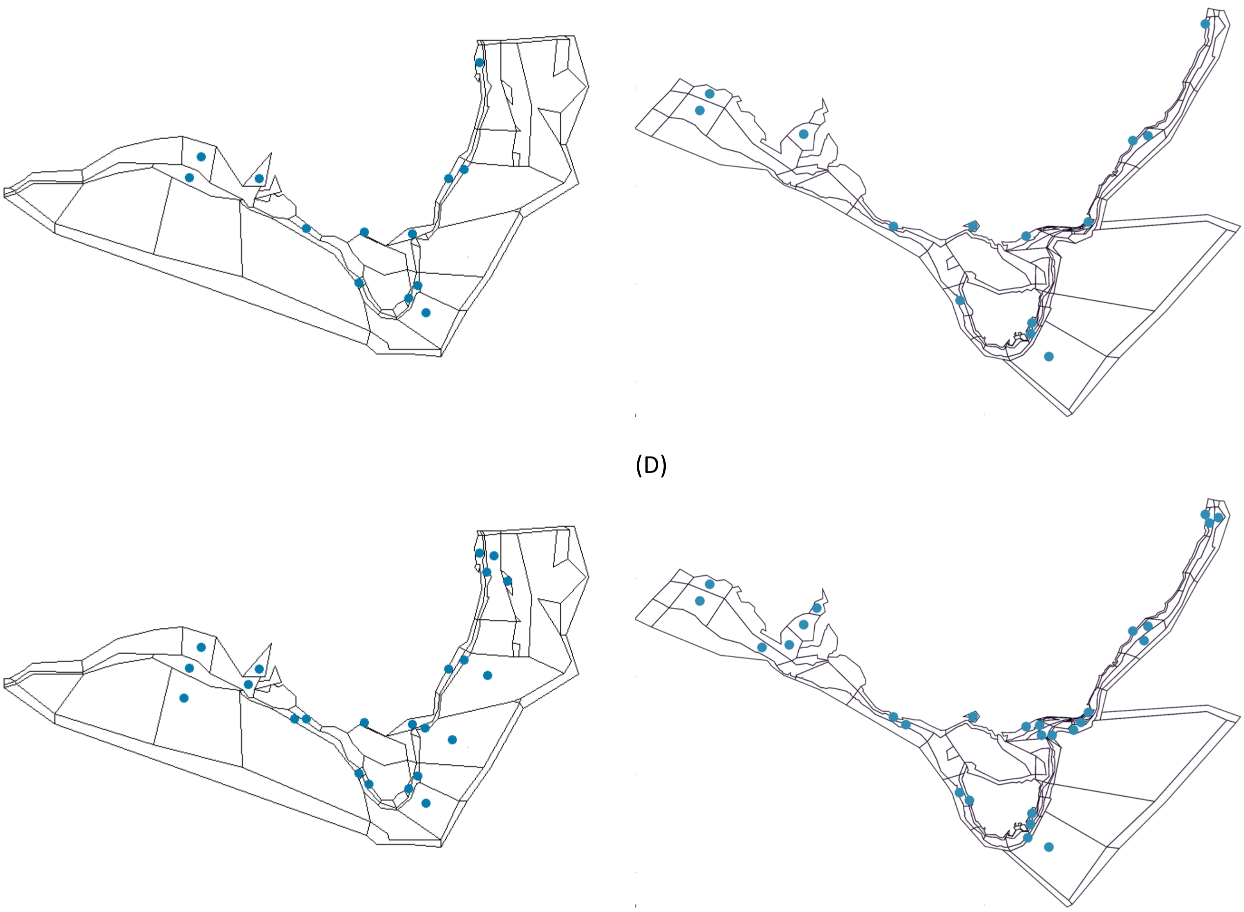


Figure 14: Sampling sites (boxes marked by blue dots) used to look at alternative monitoring schemes: (A) Atlantis-SE low monitoring coverage; (B) Atlantis-SEAP low monitoring coverage; (C) Atlantis-SE high monitoring coverage; and (D) Atlantis-SEAP high monitoring coverage.

FISHER BEHAVIOURAL STRATEGIES

Changing compliance behaviour

In the base simulation compliance rates are assumed to be quite high (> 95-99%, though the exact level is an emergent property of the behaviour of the "fishers" represented in the effort allocation model). Two other levels of changed compliance were also tested – low levels of non-compliance (roughly 10% do not comply on a regular basis) and higher levels (approximately 30% do not comply regularly). This failure to comply applies to any form of management (respecting quota, spatial management, gear limitations etc.).

Increasing recreational fishing pressure

A significant proportion of the Australian population fishes recreationally (roughly 20%, Henry and Lyle 2003). It is assumed that this rate will not significantly decline through time. It was the opinion of the workshop attendees that due to rising human population, increased affluence (or conversely subsistence needs, with recreational fishing used to supplement pension payments amongst grey nomads etc) and new "attractive trophy species" that the total recreational and charter fishing pressure may increase. This involves not only an increased magnitude of recreational fishing pressure (by fivefold), but also that the location of that pressure extends further offshore (onto pelagic species) and further south (relative distributions shown in Figure 15).

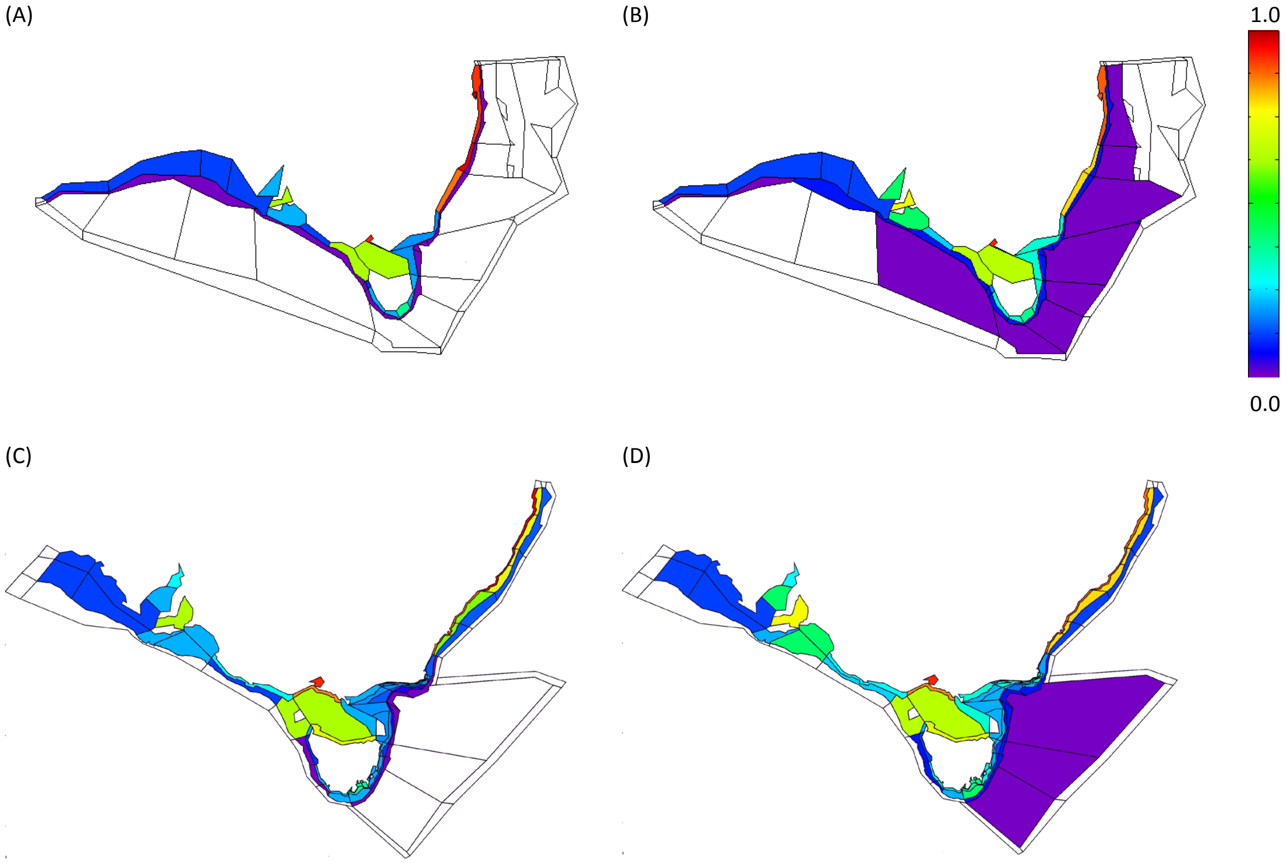


Figure 15: Relative distribution (proportional pressure versus maximum effort expenditure) of recreational fishing effort in the Atlantis-SE (A-B) and Atlantis-SEAP (C-D) models for: (A & C) status quo (as of 2010) case; and (B & D) with shifts reflective of current changes in patterns of recreational fisheries (pers comm. state fisheries managers in Tasmania, Victoria, New South Wales and Queensland). Note that for clarity (and to distinguish cells with very little pressure from cells with no fishing pressure) white cells have zero effort applied in them.

Differential exploration

Different types of fisher (those with different personality profiles) show differing degrees of exploration and modification of effort allocation patterns (spatially and when new species become commercially viable). This was implemented in the effort allocation model in Atlantis-SE by modifying the flexibility of fishers to respond to new information (rather than favouring old habits). In the status quo (as of 2010) scenario only some of the fishers have this capacity (based on fitting to observed historical effort patterns). In this strategy all fishers are given a flexibility rating 30% above the average of the most flexible fishers in the current SESSF (i.e. equivalent to the most flexible and responsive fishers in the fishery today).

For Atlantis-SEAP the CPUE-based effort allocation model did not have a simple parameter equated to psychology. To reflect flexibility in this case exploratory fishing was allowed at rates twice that in the status quo (as of 2010) case and the threshold for effort reduction was lowered by 10% (to allow for more searching for new sites rather than immediately dropping out of the fishery).

Myctophid fishery

A myctophid fishery is added to the SESSF, targeting the fish for aquaculture feed. The rate of fishing mortality applied was set equivalent to that producing maximum sustainable yield (MSY) in the work by the Smith et al (2011a) on the implications of exploiting forage fish.

Other new fisheries

A fishery for mesopelagics is added to the standard set of fisheries in each model. In Atlantis-SEAP new fisheries are also added for jellyfish, krill, microfauna (for biofuels), and kelp. For the mesopelagics the same harvest control rules as used in the Small Pelagics Fishery are used. For the other groups the Smith et al (2011a) method was applied to find the maximum sustainable yield fishing mortality rate. That rate was then used as the maximum acceptable exploitation rate, economic considerations could see less than that rate realised.

Technology creep

Improvements in technology are pervasive in fisheries. This strategy represents this by a doubling of the effective swept area over 50 years. This was done as the easiest means of representing improved efficiency as a result of more sophisticated technology, not because we expect swept area to really increase by that much. In reality the gear selectivity parameter is probably a better analogue for what technology would actually effect, but this is much more difficult to implement with a guaranteed outcome (as there are so many factors effecting realised selectivity of a gear in Atlantis).

Universally increasing demand

A lot of discussion at the stakeholder workshops focused on whether increasing affluence (or market demand), changed trade status, shifts in international supply (as other nations worry about food security or buy up import supplies) and population pressure may drive increased demand and thus increased pressure to increase effort. To represent this, effort was increased by threefold across all sectors with no change in management regulations.

Gear switching

This strategy removes gear specific access entitlements and limitations on the size of vessels allowed to be active in the fisheries, but maintains gear controls and the total number of licences. This means vessels can be “upgraded” to larger sizes and if quota is held it may be caught by any method desired.

In the vessel updating stage of the economics and fleet model of Atlantis-SE the probability of switching gears (and thus fleet within the model) or sizes is calculated based on expected returns under the different gears and the immediate cost of switching gears (i.e. fishery specific cost of installing the new gear). Gear switching could occur with any gear expected to be more profitable than their current gear (with the number of vessels switching directly related to how much more profitable the alternative gear is expected to be). As with a previous study considering gear switching using Atlantis-SE (Fulton et al 2007) had found that switching rarely happens without significant subsidies, a subsidy was included as standard in this strategy.

To allow for seasonal signatures gear switching is allowed during the monthly economic updates. This means that if probabilities of switching gear are high then vessels may switch to gear that is best matched to taking species (they are currently allowed to fish) when at their peak availability and demand. Similarly the decision to change the size of the vessel can be made in any month, though the much higher costs involved mean it is much less likely to happen. These changes may not be made mid trip, only between trips. This is a simplified representation of gear switching, as in reality not all vessels could be re-equipped with other gears. For instance, gillnet vessels could not switch to either mid-water or bottom trawl. Likewise some of the smaller shelf trawl vessels would be incapable of trawling in the deeper waters.

In Atlantis-SE when CPUE rises above the threshold that would see more effort enter the fishery the effort can instead be added to larger vessel sizes instead, depending on expected returns and relative costs.

Aquaculture practices

Aquaculture is only represented in Atlantis-SEAP. In the status quo (as of 2010) representation the industry goes on at current levels, expanding if profitable and if available suitable space remains. Alternative strategies included (i) shifting sites in response to environmental conditions, (ii) stocking densities (fry addition rates) half of those in 2010 and (iii) stocking rates twice those in 2010.

ECONOMIC SCENARIOS

Changed markets

The relative value of different species types could conceivably shift in the future (reflecting shifting demand). This may either be due to marketing or more likely changing consumer preferences there is a shift in demand between species. For example, immigrant families (or perhaps export markets) may see preferences move away from a predominance of white flesh finfish, which is then reflected in market prices for the different species.

The default market model uses an autoregressive price inflation based on time series model of sale prices from Melbourne and Sydney. This scenario represented such a shift by a change in prices, to represent the change in species preferences. This price shift was represented via alternative model coefficients in the time series model of prices – in this case set to 1.2 across the board for all species rather than varying from 0.5-1.4 across species based on historical consumer preferences (historically aside from invertebrates, which dominate the price per kilogram, rays have been least valuable and gemfish the most).

Changed costs for fisheries

There was significant concern, especially from industry representative at the workshops, that increasing cost structures would continue or be exacerbated into the future (e.g. via a price on carbon increasing fuel prices). This was captured in this scenario by using an alternative fuel prices curve – with higher intercept and rate of increase (Figure 16). Changed port access was also included to represent disruption of access to some ports (either due to competition with other industries or environmental lobby group pressures).

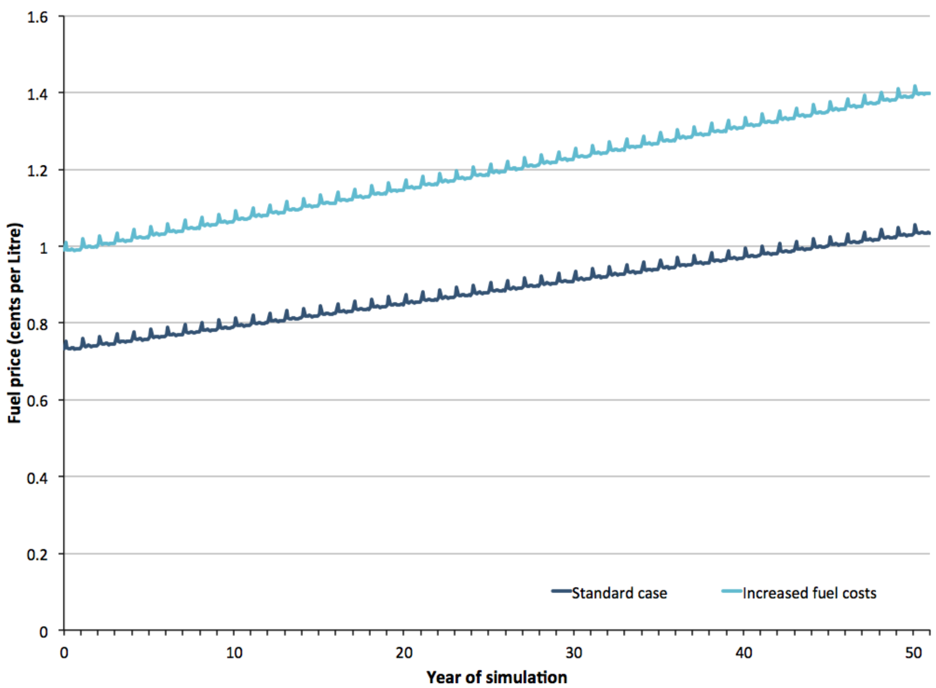


Figure 16: Fuel price trends under the standard and increased fuel costs scenarios

Aquaculture viability

This scenario looks at aquaculture costs (in place of fisheries costs of the previous scenario). It considers how changing costs and returns ($/kg for product) may see aquaculture cease to be viable in some locations. This is done by changing the costs of production and market value in-line with changes detailed above for market prices and fishing costs – for example freight charges were increased in line with assumptions around increasing fuel prices.

SCENARIOS OF PHYSICAL CLIMATE EFFECTS

Changed conditions effecting production

This scenario considers changes in the levels of stratification, turbidity, eddy strength, eddy location, upwelling strengths and hypoxia. Rather than assuming that these will lead to changed production levels, these drivers are applied via the physical model in Atlantis (both Atlantis-SE and Atlantis-SEAP) and the knock-on emergent ecological and fisheries effects directly considered. The levels of change in these physical drivers are taken from IPCC (2013, 2014). These changes were inherent to the RCP forcing realisations documented above and so were the physical drivers implemented in the majority of simulations.

Major event

In addition to the broad changes in physical drivers described above, two classes of major events (e.g. extreme El Nino) were also imposed: a large event every 5 or 10 years (starting in year 30); and a large event annually beginning in year 40 (i.e. a regime shift). In each case these events were set as forcing terms affecting primary producers and recruitment of fin-fish.

The influence of major events on primary production was matched to the outcome of past large events in the southeast region – which saw shifting composition of primary producer assemblages to favour picophytoplankton and dinoflagellates. This was achieved in both Atlantis models by increasing the mortality rates of large phytoplankton by 5% during the events. This is unlikely to be the actual mechanism in reality, but it did produce the requisite end result in terms of shifting the composition of primary production and the relative availability of energy for the microbial and “classical” food webs.

In the case of recruitment effects, a scalar was applied to the number of individuals successfully settling (or weaning) in that year. If a group was deleteriously affected by past major events then the scalar was set to reduce recruitment by 50% (20% for the reduction in sea lion pups successfully weaning) otherwise recruitment was unaffected. Based on a literature search, the groups considered to be vulnerable in this way include mackerel, small pelagics (like pilchards), myctophids, red bait, shallow demersal fish, flathead, pink ling, blue-eye trevalla, gummy shark, blue warehou, sea lions and fur seals.

Gradual change

This scenario considers a gradual change in the physical drivers of the system rather than any sudden step changes in conditions. As we have no evidence otherwise this was considered the default climate scenario in the majority of simulations.

Step changes

Workshop attendees showed interest in the possibility that climate change could happen in sudden bursts (say a large step once per decade, when some threshold is passed) rather than smooth transitions. As current patterns of change do not suggest that this is realistic, and no appropriate global circulation model output can be found to use as a basis for this scenario, it has not been possible to explore it at this time in any great depth. However, a crude example of this would be the regime shift case of the “major events” scenario described above.

ECOLOGICAL SCENARIOS

Range shifting species

Perhaps one of the clearest results of climate change (even at the level already expressed) has been shifting species distributions. The southeast region of Australia has been recognised as a global hotspot for climate change (Wu et al 2012) and initiatives like REDMAP (http://www.redmap.org.au/) and work such as that by Last et al (2011) are highlighting how species are already moving through the southeast region. The shifts in abundance have the potential to cause management concern in some regions, where populations decline, and opportunities in others, where they establish or increase (Bates et al 2014).

Based on requests by workshop attendees we have considered range extensions by a tuna species (*Katsuwonus pelamis*), a shallow demersal fish species (parameterised as *Pagrus auratus* or *Achoerodus viridis*), kingfish (*Seriola lalandi*) and a crab species (*Ranina ranina*, but only in Atlantis-SEAP). The range extension rates were taken from real world species that are observed to be moving into the southeast region of Australia (e.g. stripey tuna, pink snapper and blue groper). The range extensions began after 20 years of burn in the simulation with all age groups entering according to the behaviour of appropriate to that stage of their life histories. The shallow demersal fish and crab entered along the shelf from the most north eastern shelf box (Queensland waters), while the tuna species entered along the shelf break. The maximum rate of range extension is 430km per year, though predation, prey availability and habitat suitability means that the rate of extension was considerably lower than this upper maximum (and more in line with observed rates).

Introduced species

Other than range extensions, species can enter the system via accidental or intentional introductions. Changed climate conditions may facilitate such introductions. There was some discussion on the workshops around the issue of the introduction of pest species by aquaculture or ballast water and to explore this a bivalve (filter feeder group) and a benthic invertebrate predator (e.g. a starfish) were seeded at port sites in Atlantis-SEAP.

Disease outbreak

One of the potential outcomes of altered environmental conditions, intensified aquaculture or other system interventions, is a shift in the prevalence of epidemic disease (Harvell et al 2002). Given the history of pilchard kills in the southeast region (Whittington et al 2008), we have applied a scenario where either small pelagics, myctophids or abalone (for Atlantis-SEAP only) undergo a mass mortality event (with natural mortality going up a hundred fold for a month) roughly once every decade.

Increased variability

Even without sudden environmental changes it is possible that sudden shifts in stock status or system properties could occur under climate change as thresholds are passed. These ecological events may manifest in diverse ways: plankton blooms, recruitment failure, habitat collapses. In addition to the extreme events mentioned above under physical system effects we allowed for scenarios where there were large blooms on a semi-regular basis (either once every 5 or 10 years) or a step change in productivity (or mix of primary producers) in the system after 40 years. This not only brought with it the positive potential effects of blooms, but also the potential for hypoxia if the bloom broke down rather than entering the food chain.

Given how much of the production in the southeastern ecosystems flows through benthic and demersal food webs we also considered a scenario where biogenic habitats (such as kelps, reef and other habitat building species) are negatively effected, with their mortality rates increasing five fold for a single year (year 30 of the simulation).

Changed recruitment

It is possible that modifications to terrestrial weather patterns (e.g. rainfall) and river flow could effect the recruitment of coastal species whose reproduction or life history stage(s) are estuarine or have riverine components. Similarly, shifts in coastal habitats could impact on population viability. These species are not well represented in Atlantis-SE so scenarios for these aspects of coastal systems are only considered using Atlantis-SEAP – by changing river flow by ± 50% (with increases coming mainly in large flood events) and shifting the mix of coastal substrate types to reflect a reduction in substrate suitable for reefs and seagrass beds due to land reclamation or changed flow regimes and dredging.

Changes in offshore recruitment patterns are typically driven by changed large-scale current patterns or productivity and so are dealt with under other scenarios above.

Alternative handling of temperature dependence

Atlantis is more sophisticated than many ecological models as it conditions growth on multiple environmental traits – temperature, salinity, oxygen and habitat. Ecological models that include the influence of environmental drivers on biological processes (e.g. growth and metabolism) typically use fairly simple means of conditioning growth and other metabolic rates on environmental drivers. For example the Q_{10} temperature coefficient measures how rapidly rate parameters (e.g. growth or non-predation mortality) change when ambient temperature increases by 10 °C. For most biological systems this rate is between 2 and 3. The basic parameterisation of Atlantis assumes a Q10 of 2 for all species and uses this, absolute temperature and salinity tolerances (i.e. the ranges where species will persist) as well as habitat preferences to condition where flora and fauna can be found in the model.

More complex and nuanced influence models can be used however, such as non-linear (hump) shaped curves (e.g. Figure 17) and changes in feeding efficiency dependent upon ambient versus reference temperature levels. The use of this form of more complicated environmentally based feeding sub-model, in combination with nonlinear temperature, salinity, alkalinity and oxygen dependence has taken significant time to develop in Atlantis as the form of these relationships are only beginning to be understood empirically. This version of environmental conditioning is now standard for Atlantis-SE and Atlantis-SEAP.

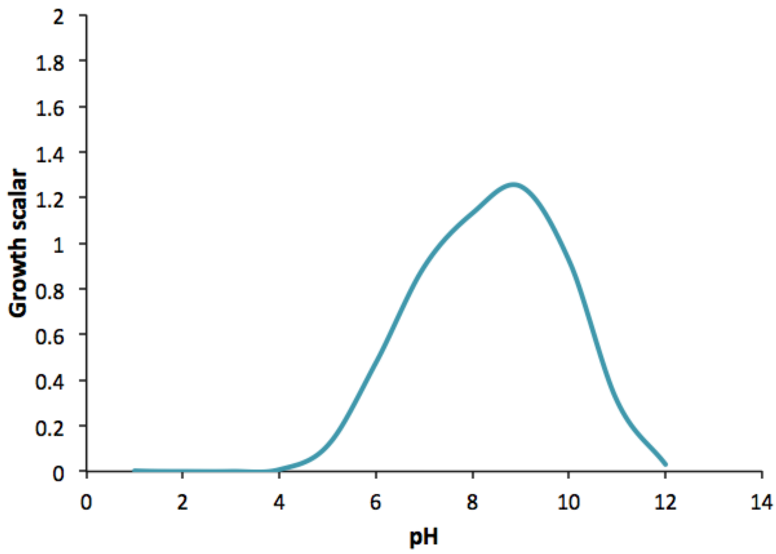


Figure 17: Example growth scalar for phytoplankton based on ocean alkalinty (modified from a lab study by Hinga 2002 using the method of Moisan et al 2002)

DEVELOPMENT SCENARIOS – NON-FISHING INDUSTRIES

Changed land use

As on-land processes can effect the marine environment (particularly if it alters riverine nutrient flow) it is important to consider changed land and catchment use (e.g. nutrients, run-off, sediments, dredging and land reclamation along coast) along side specific fisheries and marine environment scenarios. Thus the standard climate forcing scenario used for Atlantis-SE includes changed river flows (Derwent flow is reduced by 5% and the flow of all other rivers in the region is reduced by 10% versus 2010 levels) in line with that predicted by the global circulation models used to define the current systems used in the models. We also included a changed coastline and geomorphology in line with what is anticipated under the most likely projected rate of sea level rise (e.g. sea level rise maps at http://www.ozcoasts.gov.au/climate/sd_visual.jsp) and coastal development (ABS 2008).

Other offshore industries

Fisheries are just one of a number of uses of the marine environment. To reflect the increasingly multiple use nature of southeastern marine zones, a development scenario was included where there was extensive marine industries and marine multiple use management. This development scenario includes industries such as aggregate (e.g. sand) mining, oil and gas exploration (including exclusion zones around rigs and pipelines, seismic sampling, spills etc.) and shipping. The influence of these activities was represented in two ways (i) via extra spatial zoning (to represent shipping lanes and exclusion zones where fishing activity is banned) and (ii) habitat and noise impact models (where activities have a direct impact on biota), which were parameterised based on empirical studies from overseas (Hitchcock and Bell 2004, Nairn et al 2004, Newell et al 2004).

STRATEGIES OR SCENARIOS THAT WERE NOT BE RESOLVABLE

Competition between markets

Not all of the scenarios of interest to the workshop attendees can be addressed using Atlantis. Market-based aspects that are not possible in the current form of Atlantis are: (i) competition (within the market place) between fish sourced from aquaculture competes with wild caught product; and (ii) competing demand for wild caught fish (e.g. forage fish) between terrestrial industrial use (e.g. being rendered down for use in agricultural products), aquaculture (for feed) and human consumption. If this kind of competition changed the rate of exploitation or the kind of exploitation then it may be appropriate for inclusion in Atlantis, if not it may well be better to consider it using other tools (e.g. economics-based trading network model, similar to Merino et al 2012, of life cycle analysis).

Concentration of ownership

Social outcomes of system dynamics are the most difficult to capture, although they can have some of the greatest impacts on those dependent on the system. Concentration of quota ownership (which may see the loss of small operators) is a topic of interest in the southeast region. The quota trade and investment models in Atlantis allow for this kind of dynamic to emerge from a simulation. While it has emerged in some simulations it is not a guaranteed feature and to force it undermines model performance so there are no dedicated scenarios focused only on this aspect of the system.

Reporting indicators

The model projections the individual trajectories of individual species are quite uncertain. However, aggregate results have previously been found to be much more reliable indicators of potential shifts within the ecosystems. Consequently most of the biological results will be presented in terms of the gross change by broad functional type (e.g. primary producers, detritus, plankton, jellyfish, squid, benthic invertebrates, pelagic fish, demersal fish and top predators) or overall level of effect (proportion of groups with biomass changes > 40%). Similarly for socio-economic components the results have been aggregated (in terms of profits, costs and total employment) to give the relative change in the value at a fleet or overall fisheries level. For completeness individual group and fishery level responses are provided in Appendix A.

Many system level indices have been proposed over the last few decades. Not all can usefully be calculated off model data and some are not particularly informative. Consequently, biomass ratios that have previously found to be useful at ecosystem scales (pelagic:demersal fish biomass, piscivore:planktivore fish biomass) will be reported, along with two indicators being applied globally by the Indiseas initiative (http://www.indiseas.org/) - the large fish index (LFI), which is the proportion of fish (including sharks and rays) biomass >40cm in length, and mean potential longevity (MPL).

Objectives for the region – across conservation, target species stock status, economic return for the industry and employment (as a proxy for social objectives) – were defined based on objectives identified as important by stakeholders in the region (Jennings et al 2013). The aggregate indices used to judge performance against these objectives were:

- relative biomass of demersal fish and chondrichthyans
- relative biomass of pelagic fish and chondrichthyans
- relative biomass of macroinvertebrates
- relative aggregate biomass of mammals, seabirds, large pelagic sharks and gulper sharks (i.e. the major threatened, endangered and protected groups)
- overall proportion of stocks rated as vulnerable or exposed
- biodiversity
- primary production
- large fish index (as also an index of trophy fish biomass, which is of interest to recreational users)
- relative landings
- relative employment
- relative effort
- GVPUE

To help simplify interpretation of the tradeoffs between these objectives and the performance against the various management objectives, a hierarchical cluster analysis, with complete linkage, and a principle components analysis (PCA) were performed (using the R software – R 2.10.1 GUI 1.31 Leopard build 64-bit (5337)) using the aggregate indices to see if the outcomes of the simulations clustered.

The hierarchical clustering algorithm uses a set of dissimilarities for the objects being clustered (i.e. the distance between the objects in multi-dimensional space) to find groups of outcomes (in this case management strategy-scenario combinations) that clump together. Initially, each object is assigned to its own singleton cluster (i.e. the tips of the branches) and then the algorithm iteratively joins the two most similar clusters until there is just one cluster containing all of the objects (the root of the final dendrogram). The "complete" method used means that the focus is on finding compact spherical clusters.

Principal components analysis is another way of looking at high dimensional data. It uses an orthogonal transformation to map higher dimension (potentially correlated) variables onto linearly uncorrelated principal components so that the axes of maximum variability are visible. By overlaying how individual variables align with each axis it can be seen what is causing the majority of the variance in the higher dimensional space. By coding the points in the PCA based on their strategy-scenario combination it is possible to see if certain strategies or scenarios map together – this provides an indication of a particular case is quite distinct to the others or if certain strategies or scenarios create discernible clusters (i.e. lead to similar system outcomes).

Interaction effects and network analysis

Individual, additive, and interaction effect sizes (on biomass for each group) for each model scenario and strategy was considered using Hedge's d, which is similar to an analysis of variance in that a significant interaction effect indicates deviation from the null model of additivity (Hedges and Olkin 1985, Morris et al 2007, Crain et al 2008). Interaction effects are classified as antagonistic (reduced stress), additive (no additional stress), or synergistic (amplified stress). For stressor combinations whose individual or additive effects are negative, interaction effect sizes whose 95% confidence intervals overlapped zero are classified as additive; interaction effect sizes of <0 are synergistic; and interaction effect sizes >0 are antagonistic. When individual or additive effects were all positive, interactions were interpreted in the opposite manner.

To identify key structural importance in simulated foodwebs through time Griffith et al (in press) used a graph-theoretical method (applied to the effect sizes calculated for the interactions explored in Griffith et al 2012) to explore system structure and dependencies. We used their key player and broker species analyses (developed from sociometric methods), to consider the extent to which individual groups contributed to food web cohesiveness under the different emissions scenarios. We focused on these indices from network science as they have proved ecologically meaningful in the analysis of complex marine food webs (Jordán et al 2006, Dambacher et al 2010, Lai et al 2012). This network analysis identified the broker species, which lie on all shortest paths of intersection between other species and so mediate many indirect interactions between species (Borgatti and Everett 2006). These represent potential points of failure in the food web (i.e. their decline or removal would radically restructure the web and system flows). To analyse the extent to which a group maintains food web cohesiveness we used key player analysis (developed from sociometrics). These key players are identified via looking at which removals would fragment the web and also which groups reach the most other groups in the food web (Dambacher et al 2010). Indices were calculated by using UCINET (Borgatti et al 2002).

Additional information

The major aspects of the system – biological, economic and social – are summarised here, with tradeoffs highlighted in "spider plots" which show the relative performance of the major types of management strategy against the major objectives for the system. However, there is far more detail that sits behind these aggregate results. Rather than overload this report we have chosen to upload the simulation results to **sea**view website (www.csiro.au/seaview) instead so they can be explored at the reader's leisure. The library will be populated with all existing runs from both models and incrementally updated as new strategies are suggested or the models updated with new information (the rate of update will slow down once the project is complete).

In addition, different aspects of early iterations of the simulations were explored by the authors and associated researchers (Fulton 2011; Griffith et al 2011, 2012; Brown et al 2012). Key findings will be highlighted in the results and discussions. Some of the methods developed for the earlier runs have been applied to the final Atlantis-SE and Atlantis-SEAP simulations too and will also be reported in the results – in particular, the effect of management delays; a changing understanding of potential physical change in the southeast; the interactive effects of climate; ocean acidification and fisheries; and network analysis to identify key trophic connections that control the expression of the interaction effects.

Results

Atlantis-SE

STOCK STATUS

The final mean relative biomasses per group in the final 5 years of each scenario-strategy combination for Atlantis-SE can be found in Tables A.1-A.3. These biomasses show quite a strong non-linear response to the emissions scenario. When the 2010 climate conditions are run continuously (i.e. no climate change) under status quo management 46.4% (± 7%) of the groups increased in biomass by more than 40%, while 12% (± 6%) decreased by 40% or more. Under RCP 3, allowing for acclimation and evolution, fewer groups increase (25-37% across the various management strategies), while more decrease (20-40%). There are many more decreases if there is no acclimation (roughly 55%), though there are a similar number of increases (22-33%). Under RCP 4.5 the results are far more variable across the parameterisations, so while the mean level of increases in relative biomass is higher (with 46-55% of groups increasing with or without acclimation) the confidence bands are an order of magnitude larger (± 28-36% rather than ±1-7%). The numbers of groups declining is also fairly variable across management strategies and parameterisations with 16-30% (±12-20%) of groups declining with acclimation and 40-42% (± 35-30%) without allowing for evolution and acclimation. Under an RCP 8.5 emissions scenario the variability has dropped away again with 30-40% (± 1-4%) of groups increasing by more than 40% with acclimation, but only 22-32% (± 1-3%) without acclimation. The number of groups declining is also more consistent across parameterisations, though showing stronger differentiation across management strategies, with 14-30% (±1-5%) declining with acclimation and 52-55% (±3.5-8%) without it.

There is variation in which groups change between parameterisation-strategy-scenario combinations. However, there is enough consistency to provide a rough characterisation of which groups tend to increase and which decrease (Table 7). In general the pelagic groups tend to increase, along with many (but not all) of the shallower dwelling target species when under intensive or integrated management, while deep water bycatch and byproduct species, and calcifying invertebrates tend to decrease. Allowing for acclimation led to less extreme outcomes then if static parameterisations are used. Nevertheless, even that was insufficient when considering a range extension of a shallow demersal fish under RCP 8.5 and low productivity parameterisations. In that instance such a substantial restructuring of the system occurred that the simulation became numerically unstable and the simulation terminates after only 40 years (it cannot run for the full 70 years). This is kind of change exceeds what the current model can reliably capture and is beyond that seen previously in the study by Fulton (2011).

In terms of which classes of groups increase and decrease that is dependent upon combinations of scenarios, strategies and parameterisations Tables 8-10. In all cases more productive and resilient parameterisations can see some demersal fish stocks increasing in biomass, but the clear pattern was that regardless of emissions scenario decreases in demersal fish biomass were likely under cumulative impacts, particularly if there is no acclimation or evolution. Results were mixed across management strategies, with the healthiest demersal stocks resulting from extensive use of spatial management or seasonal closures, high levels of compliance with fisheries regulations or integrated management across all activities. Patterns are less tidy for other groups of species. Pelagics tend to increase in all cases (so long as acclimation is allowed for), but isn't as strong under the higher levels of emissions – with forage fish responding with a 3-4 fold increase in biomass under RCP 3, 2-3 fold increase under RCP 4.5, but at best only a 5-30% increase under RCP 8.5 (where cumulative impacts could actually see a decline in relative biomass); a similar drop off in increases with increasing RCP is also seen for primary production (though the decline is not as strong as the macrophytes are influenced most by productivity parameterisations). The response in the predatory pelagic fish (e.g. tuna) is more consistent across RCP 3 and RCP 4.5 (increasing by roughly 10-50% in most

Table 7: Characterisation of clear relative biomass response of groups in Atlantis-SE to climate change, development and management scenarios and their potential cumulative impacts. Groups not listed either did not increase (decrease) by > 20% or had variable responses (i.e. dependent on parameterisation)

Emissions scenario	Management & Developments	Increasing biomass		Decreasing biomass	
RCP 3	Intensive or integrated	mackerel morwong cardinalfish gemfish spotted warehou flathead piscivores red bait shallow demersals pink ling gummy shark meiobenthos	school shark dolphins baleen whales orca sea lion deep crustaceans lobster deposit feeders macroalgae worms diatoms bacteria	blue grenadier blueeye trevalla gulper shark	scallops
	Cumulative impacts	spotted warehou school whiting gummy shark dolphins meiobenthos	baleen whales deposit feeders macroalgae diatoms bacteria	cardinalfish gemfish piscivores other mesopelagics dories and oreos shallow demersals gulper shark	orca scallops urchins and abalone deep crustaceans shallow crustaceans prawns jellies
	Other	spotted warehou pink ling school whiting red bait gummy shark school shark meiobenthos	deepwater dogfish dolphins baleen whales deposit feeders macroalgae diatoms bacteria	cardinalfish gemfish piscivores myctophids blue grenadier shallow demersals	blueeye trevalla gulper shark scallops urchins and abalone deep crustaceans shallow crustaceans
RCP 4.5	Intensive or integrated	mackerel spotted warehou red bait pink ling deposit feeders diatoms microzooplankton meiobenthos	gummy sharks school shark deepwater dogfish baleen whales dolphins macroalgae seagrass	scallops	
	Cumulative impacts	mackerel spotted warehou school whiting other mesopelagics red bait diatoms bacteria meiobenthos	school shark dolphins deposit feeders macroalgae seagrass jellies microzooplankton	cardinalfish gemfish piscivores squid scallops	
	Other	mackerel pilchards spotted warehou school whiting red bait diatoms bacteria meiobenthos	deepwater dogfish school shark dolphins deposit feeders macroalgae jellies microzooplankton	cardinalfish squid scallops	

Emissions scenario	Management & Developments	Increasing biomass		Decreasing biomass	
RCP 8.5	Intensive or integrated	mackerel morwong pilchards cardinalfish gemfish skates and rays seals baleen whale orca krill diatoms Meiobenthos detritus	spotted warehou red bait ribaldo pink ling deepwater dogfish pelagic sharks seabirds dolphins squid macroalgae seagrass bacteria	dories and oreos flathead school shark scallops oysters	deep filter feeders urchins and abalone
	Cumulative impacts	mackerel morwong pilchards baleen whales diatoms detritus	spotted warehou ribaldo deepwater dogfish dolphins bacteria meiobenthos	cardinalfish gemfish piscivores dories and oreos gulper shark scallops oysters deep crustaceans prawns	other mesopelagics shallow demersals flathead school shark orca deep filter feeders urchins and abalone lobster shallow crustaceans
	Other	mackerel morwong pilchards red bait skates and rays seals baleen whales krill diatoms Meiobenthos detritus	spotted warehou school whiting ribaldo gummy shark deepwater dogfish dolphins orca macroalgae seagrass bacteria	myctophids other mesopelagics dories and oreos flathead scallops oysters deep crustaceans	school shark gulper shark deep filter feeders urchins and abalone lobster shallow crustaceans prawns
No acclimation		spotted warehou school whiting gummy shark seagrass detritus		cardinalfish gemfish piscivores tuna myctophids other mesopelagics red bait dories and oreos shallow demersals blueeye trevalla demersal sharks school shark seals gulper shark	dolphins ocra baleen whales scallops oysters urchins and abalone deep crustaceans lobster shallow crustaceans prawns deposit feeders

Table 8: Range of change (by 2065-2070) in broad classes of functional groups in Atlantis SE under the RCP 3 emissions scenario

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
No Climate change - 2010 context - SQ	0.9 - 4.14	1.19 - 2.33	0.94 - 3.05	1.15 - 1.77	0.33 - 2.88	1.24 - 7.51	0.85 - 2.03
2010 coastal context - Cap ecosystem take	0.22 - 1.08	0.75 - 0.98	1.03 - 4.44	0.82 - 4.96	0.54 - 4.32	0.24 - 1.32	0.08 - 0.39
2010 coastal context - Centralised mgmt.	0.24 - 2.02	0.74 - 1.52	1.06 - 7.64	0.74 - 7.78	0.24 - 3.97	0.28 - 1.58	0.03 - 0.47
2010 coastal context - FewMPA	0.23 - 0.63	0.64 - 0.97	0.85 - 5.3	0.31 - 2.36	0.29 - 4.22	0.17 - 1.49	0 - 0.01
2010 coastal context - Fragmented mgmt	0.22 - 2.01	0.66 - 1.5	0.99 - 7.56	0.18 - 4.57	0.38 - 3.91	0.21 - 1.51	0.14 - 0.25
2010 coastal context - ManyMPA	0.43 - 3.35	1.15 - 1.62	1.06 - 8.51	0.23 - 1.86	0.3 - 4.68	0.22 - 1.32	0.75 - 3.53
2010 coastal context - Seasons	0.43 - 3.3	1.17 - 1.74	1.06 - 8.8	0.2 - 2.01	0.29 - 3.69	0.23 - 1.22	0.74 - 3.56
2010 coastal context - SlowAssess	0.48 - 1.46	0.94 - 1.49	1.24 - 7.29	1.03 - 4.65	0.45 - 4.02	0.21 - 1.05	0.11 - 2.44
2010 coastal context - Integrated Mgmt (IM)	0.56 - 1.92	0.7 - 1.51	0.94 - 10.16	1.08 - 5.35	0.7 - 4.97	0.46 - 5.85	0.32 - 270.17
Cumulative impacts - 2010 Status Quo (SQ)	0.3 - 0.86	0.89 - 1.46	0.83 - 5.94	1.23 - 12.52	0.27 - 4.08	0.2 - 1.01	0 - 0.03
Cumulative impacts - Cap ecosystem take	0.3 - 0.54	0.84 - 1.15	0.84 - 3.62	0.64 - 21.11	0.56 - 4.19	0.23 - 0.86	0 - 258.84
Cumulative impacts - Centralised mgmt.	0.32 - 0.94	0.94 - 1.51	0.86 - 6.23	0.57 - 16.75	0.25 - 3.84	0.27 - 1.03	0 - 0.09
Cumulative impacts - FewMPA	0.29 - 0.31	0.6 - 1.34	0.69 - 4.32	0.24 - 1.67	0.3 - 4.09	0.16 - 0.97	0 - 0.02
Cumulative impacts - Fragmented mgmt	0.3 - 0.93	0.94 - 1.49	0.81 - 6.17	0.14 - 12.81	0.4 - 3.79	0.2 - 1.11	0 - 0.09
Cumulative impacts - ManyMPA	0.59 - 1.55	1.12 - 1.75	0.86 - 6.95	0.18 - 0.9	0.31 - 4.53	0.21 - 0.89	0 - 0.18
Cumulative impacts - Seasons	0.59 - 1.53	1.29 - 1.79	0.86 - 7.18	0.16 - 0.97	0.3 - 3.57	0.22 - 0.79	0 - 0.15
Cumulative impacts - SlowAssess	0.51 - 0.67	0.95 - 1.48	1.01 - 5.95	0.57 - 2.25	0.46 - 3.89	0.21 - 1.1	0 - 0.08
Cumulative impacts - IM	0.61 - 0.89	0.69 - 2.19	0.76 - 8.29	0.52 - 1.07	0.31 - 2.88	0.44 - 6.12	0 - 2.67
Expanded LTL fishery - IM	0.25 - 2.1	0.65 - 1.46	1.08 - 7.93	1.71 - 11.16	0.33 - 4.28	0.18 - 1.32	0.2 - 4.98
New mesopelgic fishery - IM	0.25 - 2.1	0.65 - 1.46	1.12 - 7.93	0.65 - 10.72	0.33 - 4.28	0.18 - 1.34	0.2 - 4.98
Extreme climate events - IM	0.22 - 2.12	0.68 - 1.48	1.03 - 7.48	1.52 - 24.69	0.32 - 3.75	0.21 - 1.11	0.03 - 2.31
Blooms - IM	0.21 - 2.14	0.66 - 1.52	0.99 - 7.65	1.59 - 37.25	0.38 - 3.57	0.18 - 1	0.04 - 3.1
Primary production regime shift - IM	0.22 - 1.96	0.66 - 1.49	1.01 - 7.36	2.99 - 27.39	0.26 - 3.18	0.16 - 0.97	0.3 - 1.49
Fish kills - IM	0.21 - 1.86	0.65 - 1.47	1 - 7.27	1.58 - 25.24	0.26 - 3.59	0.21 - 1.48	0.06 - 1
Range extensions - IM	0.24 - 2.09	0.85 - 1.5	0.94 - 7.74	1.28 - 22.74	0.31 - 3.66	0.26 - 2.02	0.06 - 3.42
Gear switching allowed - IM	0.48 - 3.26	1.23 - 1.76	1.04 - 8.56	0.24 - 12.02	0.36 - 3.01	0.2 - 1.22	0.73 - 35.08
High compliance - IM	0.24 - 1.52	0.65 - 1.43	1.06 - 6.98	2.33 - 22.74	0.44 - 3.92	0.25 - 2.02	0.15 - 0.46

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
Low Compliance - IM	0.23 - 1.31	0.62 - 1.73	0.93 - 7.54	2.65 - 24.33	0.34 - 3.66	0.17 - 1.27	0.01 - 0.81
Flexible fisher behaviour - IM	0.23 - 2.48	0.72 - 1.54	1 - 7.45	0.66 - 18.97	0.24 - 2.89	0.2 - 1.25	0.12 - 5.17
Increased fishing pressure drivers - IM	0.22 - 1.86	0.66 - 1.47	1.02 - 7.27	2.64 - 25.89	0.26 - 4.21	0.21 - 1.55	0.04 - 1
High Cost, Low Values - IM	0.45 - 2.59	1.21 - 1.37	1.06 - 8.96	0.17 - 1.7	0.38 - 4.2	0.23 - 1	0.75 - 36.03
Low Costs, High Values - IM	0.23 - 0.79	0.21 - 1.01	1.03 - 2.44	0.81 - 21.95	0.83 - 4.43	0.27 - 1.08	0.13 - 525.31
Standard Markets - IM	0.22 - 1.86	0.66 - 1.47	1.02 - 7.27	1.58 - 25.89	0.26 - 4.21	0.21 - 1.55	0.04 - 1
Technology Creep - IM	0.44 - 2.84	0.77 - 1.39	1.18 - 9.61	0.4 - 3.42	0.36 - 4.21	0.19 - 1.95	0.45 - 20.61
No Acclimation - 2010 coastal context - IM	0.1 - 0.82	0.15 - 0.55	0.66 - 1.3	0.11 - 4.88	0.07 - 0.49	0.37 - 2.83	0 - 0.17
No Acclimation - Cumulative impacts - SQ	0.05 - 0.73	0.33 - 0.35	0.55 - 0.8	0.15 - 56.51	0.06 - 0.79	0.13 - 1.08	0 - 29.35

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	0.61 - 0.69	1 - 1.32	0.62 - 1.35	1.07 - 1.27	1 - 1.43	0.93 - 1.21	16.26 - 33.83
2010 coastal context - Cap ecosystem take	0.38 - 0.74	0.65 - 0.7	0.71 - 2.07	1.07 - 1.08	2.05 - 3.15	2.15 - 2.34	12.84 - 70.17
2010 coastal context - Centralised mgmt.	0.28 - 0.74	0.39 - 0.71	0.34 - 2.07	1.07 - 1.13	2.04 - 4.93	2.15 - 2.89	12.82 - 110.29
2010 coastal context - FewMPA	0.21 - 0.51	0.23 - 0.42	0.35 - 2.1	1.08 - 1.14	2.07 - 4.95	2.21 - 2.96	12.88 - 110.42
2010 coastal context - Fragmented mgmt	0.28 - 0.73	0.38 - 0.71	0.34 - 2.07	1.07 - 1.14	2.05 - 4.94	2.14 - 2.9	12.82 - 110.31
2010 coastal context - ManyMPA	0.29 - 0.76	0.46 - 0.83	0.33 - 2.06	1.06 - 1.12	2.03 - 4.9	2.12 - 2.85	12.78 - 110.04
2010 coastal context - Seasons	0.29 - 0.76	0.48 - 0.8	0.33 - 2.06	1.06 - 1.12	2.03 - 4.89	2.12 - 2.85	12.78 - 110.04
2010 coastal context - SlowAssess	0.28 - 1	0.38 - 1.25	0.34 - 2.06	1.07 - 1.14	1.45 - 4.95	2.15 - 2.91	12.83 - 110.38
2010 coastal context - Integrated Mgmt (IM)	0.26 - 0.72	0.66 - 1.3	0.32 - 1.89	1.07 - 1.24	0.95 - 3.25	0.95 - 1.52	9.6 - 100.77
Cumulative impacts - 2010 Status Quo (SQ)	0.24 - 0.59	0.22 - 0.42	0.36 - 2.16	1.12 - 1.19	2.12 - 5.08	2.34 - 3.15	20.98 - 110.86
Cumulative impacts - Cap ecosystem take	0.35 - 0.59	0.35 - 0.43	0.76 - 2.15	1.12 - 1.12	2.11 - 3.23	2.33 - 2.53	20.96 - 70.49
Cumulative impacts - Centralised mgmt.	0.24 - 0.59	0.22 - 0.43	0.36 - 2.15	1.12 - 1.18	2.1 - 5.06	2.32 - 3.13	20.94 - 110.79
Cumulative impacts - FewMPA	0.17 - 0.41	0.2 - 0.34	0.37 - 2.19	1.13 - 1.19	2.13 - 5.08	2.39 - 3.21	30 - 110.93
Cumulative impacts - Fragmented mgmt	0.24 - 0.59	0.22 - 0.43	0.36 - 2.16	1.11 - 1.18	2.11 - 5.07	2.32 - 3.14	20.94 - 110.81
Cumulative impacts - ManyMPA	0.24 - 0.61	0.23 - 0.45	0.35 - 2.14	1.11 - 1.17	2.09 - 5.03	2.29 - 3.08	20.9 - 110.53
Cumulative impacts - Seasons	0.25 - 0.61	0.23 - 0.45	0.35 - 2.14	1.11 - 1.17	2.09 - 5.02	2.3 - 3.08	20.9 - 110.53

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Cumulative impacts - SlowAssess	0.23 - 0.81	0.22 - 0.74	0.36 - 2.15	1.12 - 1.19	1.5 - 5.08	2.32 - 3.15	20.95 - 110.89
Cumulative impacts - IM	0.23 - 0.6	0.41 - 0.92	0.34 - 2.2	1.12 - 1.29	0.99 - 3.34	1.04 - 1.64	10.3 - 105.23
Expanded LTL fishery - IM	0.29 - 0.75	0.4 - 0.73	0.34 - 2.07	1.07 - 1.13	2.04 - 4.94	2.14 - 2.89	10.86 - 110.4
New mesopelgic fishery - IM	0.29 - 0.76	0.4 - 0.76	0.34 - 2.07	1.06 - 1.13	2.04 - 4.94	2.14 - 2.89	10.86 - 110.4
Extreme climate events - IM	0.28 - 0.73	0.38 - 0.7	0.34 - 2.07	1.07 - 1.14	2.05 - 4.94	2.16 - 2.9	10.86 - 110.31
Blooms - IM	0.28 - 0.73	0.38 - 0.69	0.33 - 2.07	1.07 - 1.13	2.06 - 4.94	2.16 - 2.89	10.86 - 110.28
Primary production regime shift - IM	0.28 - 1.3	0.37 - 1.31	0.34 - 2.07	1.07 - 1.14	1.37 - 4.95	2.19 - 2.9	10.97 - 110.34
Fish kills - IM	0.28 - 0.73	0.37 - 0.69	0.34 - 2.07	1.07 - 1.14	2.05 - 4.95	2.15 - 2.91	10.85 - 110.36
Range extensions - IM	0.29 - 0.76	0.39 - 0.68	0.33 - 2.07	1.07 - 1.13	2.04 - 4.93	2.16 - 2.89	10.85 - 110.28
Gear switching allowed - IM	0.29 - 0.75	0.48 - 0.79	0.33 - 2.06	1.06 - 1.12	2.03 - 4.9	2.12 - 2.85	10.78 - 110.04
High compliance - IM	0.28 - 0.74	0.36 - 0.72	0.34 - 2.07	1.07 - 1.14	2.04 - 4.96	2.14 - 2.92	10.82 - 110.43
Low Compliance - IM	0.28 - 0.7	0.38 - 0.67	0.34 - 2.09	1.08 - 1.14	2.05 - 4.96	2.16 - 2.91	10.87 - 110.38
Flexible fisher behaviour - IM	0.29 - 0.74	0.39 - 0.71	0.33 - 2.07	1.07 - 1.13	2.04 - 4.93	2.15 - 2.88	10.83 - 110.22
Increased fishing pressure drivers - IM	0.28 - 0.73	0.37 - 0.7	0.34 - 2.07	1.07 - 1.14	2.05 - 4.95	2.16 - 2.91	10.86 - 110.36
High Cost, Low Values - IM	0.29 - 0.76	0.51 - 0.81	0.33 - 2.06	1.06 - 1.12	2.03 - 4.89	2.12 - 2.85	10.78 - 110.03
Low Costs, High Values - IM	0.43 - 0.74	0.7 - 0.93	1.06 - 2.08	1.02 - 1.07	1.35 - 2.15	1.77 - 2.19	10.83 - 20.98
Standard Markets - IM	0.28 - 0.73	0.37 - 0.7	0.34 - 2.07	1.07 - 1.14	2.05 - 4.95	2.16 - 2.91	10.86 - 110.36
Technology Creep - IM	0.29 - 0.75	0.43 - 0.75	0.33 - 2.06	1.06 - 1.12	2.04 - 4.9	2.13 - 2.86	10.8 - 110.09
No Acclimation - 2010 coastal context - IM	0.12 - 0.39	0.26 - 0.69	0.51 - 2.03	0.93 - 1.23	0.94 - 2.28	0.93 - 1.25	10.87 - 230.94
No Acclimation - Cumulative impacts - SQ	0.16 - 0.34	0.15 - 0.28	0.54 - 2.18	0.86 - 1.17	1.98 - 3.47	1.76 - 2.4	10.42 - 200.82

Table 9: Range of change (by 2065-2070) in broad classes of functional groups in Atlantis SE under the RCP 4.5 emissions scenario

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
No Climate change - 2010 context - SQ	0.9 - 4.14	1.19 - 2.33	0.94 - 3.05	1.15 - 1.77	0.33 - 2.88	1.24 - 7.51	0.85 - 2.03
2010 coastal context - Cap ecosystem take	0.38 - 0.82	0.62 - 1.05	1.03 - 2.36	0.88 - 5.29	1.34 - 3.13	0.3 - 5.09	0.08 - 27.72
2010 coastal context - Centralised mgmt.	0.4 - 1.21	0.61 - 1.89	1.06 - 3.87	0.79 - 8.31	0.6 - 2.87	0.35 - 5.71	0 - 0.29
2010 coastal context - FewMPA	0.38 - 0.44	0.67 - 1.2	0.85 - 2.68	0.33 - 2.52	0.71 - 3.05	0.22 - 5.31	0 - 22.15
2010 coastal context - Fragmented mgmt	0.37 - 1.2	0.55 - 1.87	1 - 3.83	0.19 - 4.88	0.94 - 2.83	0.26 - 6.74	0 - 0.14
2010 coastal context - ManyMPA	0.74 - 2.01	0.95 - 2.01	1.06 - 4.31	0.25 - 1.98	0.74 - 3.38	0.28 - 5.4	0.04 - 1.51
2010 coastal context - Seasons	0.74 - 1.98	0.97 - 2.17	1.06 - 4.46	0.22 - 2.15	0.71 - 2.67	0.29 - 4.59	0.04 - 1.51
2010 coastal context - SlowAssess	0.77 - 0.87	0.78 - 1.85	1.24 - 3.69	1.11 - 4.97	1.1 - 2.91	0.27 - 6.69	0 - 1.54
2010 coastal context - Integrated Mgmt (IM)	0.91 - 1.15	0.87 - 1.59	0.94 - 5.14	1.15 - 5.48	1.14 - 4.15	0.58 - 37.23	0.32 - 2.86
Cumulative impacts - 2010 Status Quo (SQ)	0.51 - 0.56	0.83 - 1.82	0.83 - 3.01	1.32 - 13.38	0.66 - 2.95	0.25 - 6.04	0 - 255.32
Cumulative impacts - Cap ecosystem take	0.3 - 0.56	0.95 - 1.04	0.84 - 1.83	0.69 - 22.55	1.39 - 3.03	0.29 - 5.32	0 - 0.27
Cumulative impacts - Centralised mgmt.	0.55 - 0.68	0.93 - 1.88	0.87 - 3.16	0.62 - 17.89	0.62 - 2.78	0.34 - 5.97	0 - 0.01
Cumulative impacts - FewMPA	0.17 - 0.53	0.63 - 1.2	0.69 - 2.19	0.26 - 1.78	0.73 - 2.96	0.21 - 5.55	0 - 0.02
Cumulative impacts - Fragmented mgmt	0.51 - 0.59	0.84 - 1.86	0.81 - 3.13	0.15 - 13.68	0.97 - 2.74	0.25 - 7.05	0 - 0.1
Cumulative impacts - ManyMPA	0.93 - 1.09	1.19 - 2	0.86 - 3.52	0.19 - 0.96	0.76 - 3.28	0.26 - 5.65	0 - 0.05
Cumulative impacts - Seasons	0.72 - 1.01	1.36 - 2.16	0.86 - 3.64	0.17 - 1.04	0.73 - 2.58	0.28 - 4.8	0 - 0.05
Cumulative impacts - SlowAssess	0.4 - 1.12	1 - 1.84	1.01 - 3.01	0.58 - 2.4	1.14 - 2.81	0.26 - 7	0.01 - 0.03
Cumulative impacts - IM	0.53 - 1.31	0.86 - 1.82	0.76 - 4.2	0.56 - 1.09	0.77 - 2.08	0.56 - 38.94	0 - 0.02
Expanded LTL fishery - IM	0.43 - 1.26	0.53 - 1.82	1.08 - 4.02	1.84 - 11.92	0.81 - 3.1	0.23 - 3.92	0.01 - 0.4
New mesopelgic fishery - IM	0.42 - 1.26	0.54 - 1.82	1.12 - 4.02	0.7 - 11.45	0.81 - 3.22	0.23 - 3.92	0.01 - 1.15
Extreme climate events - IM	0.37 - 1.27	0.56 - 1.85	1.03 - 3.78	1.63 - 26.38	0.8 - 2.72	0.26 - 6.14	0 - 0.22
Blooms - IM	0.36 - 1.28	0.54 - 1.9	0.99 - 3.88	1.71 - 39.79	0.93 - 2.58	0.23 - 6.33	0 - 0.13
Primary production regime shift - IM	0.37 - 1.6	0.55 - 1.86	1.01 - 3.73	3.2 - 29.26	0.64 - 2.3	0.21 - 5.44	0 - 0.65
Fish kills - IM	0.36 - 1.11	0.54 - 1.83	1 - 3.68	1.7 - 26.96	0.64 - 2.59	0.26 - 6.09	0 - 0.19
Range extensions - IM	0.41 - 1.25	0.7 - 1.86	0.94 - 3.92	1.38 - 24.29	0.76 - 2.65	0.33 - 5.07	0 - 0.29
Gear switching allowed - IM	0.82 - 2.01	1.02 - 2.19	1.04 - 4.33	0.26 - 12.84	0.88 - 2.25	0.26 - 4.64	0.04 - 1.5
High compliance - IM	0.41 - 0.91	0.54 - 1.78	1.06 - 3.53	2.5 - 24.29	1.08 - 2.84	0.31 - 4.68	0 - 0.29

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
Low Compliance - IM	0.39 - 0.79	0.52 - 2.15	0.93 - 3.82	2.85 - 25.99	0.85 - 2.65	0.22 - 4.69	0 - 0.03
Flexible fisher behaviour - IM	0.4 - 1.49	0.59 - 1.92	1 - 3.77	0.7 - 20.26	0.59 - 2.09	0.25 - 6.4	0.01 - 0.31
Increased fishing pressure drivers - IM	0.37 - 1.11	0.54 - 1.83	1.03 - 3.68	2.83 - 27.66	0.64 - 3.05	0.26 - 5.77	0 - 0.23
High Cost, Low Values - IM	0.78 - 1.61	1.02 - 1.7	1.06 - 4.53	0.19 - 1.82	0.93 - 3.04	0.29 - 4.99	0.04 - 1.51
Low Costs, High Values - IM	0.18 - 0.82	0.27 - 1.06	0.81 - 2.47	0.83 - 23.45	2.04 - 3.21	0.34 - 4.4	0.01 - 0.26
Standard Markets - IM	0.37 - 1.11	0.54 - 1.83	1.03 - 3.68	1.7 - 27.66	0.64 - 3.05	0.26 - 5.77	0 - 0.23
Technology Creep - IM	0.75 - 1.7	0.64 - 1.74	1.18 - 4.86	0.43 - 3.66	0.88 - 3.05	0.24 - 5.74	0.02 - 1.35
No Acclimation - 2010 coastal context - IM	0.18 - 0.84	0.19 - 0.59	0.39 - 1.31	0.12 - 5.21	0.17 - 0.36	0.47 - 5.16	0 - 0.1
No Acclimation - Cumulative impacts - SQ	0.09 - 0.75	0.28 - 0.41	0.28 - 0.81	0.16 - 60.36	0.14 - 0.74	0.21 - 0.84	0 - 0.12

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	0.61 - 0.69	1 - 1.32	0.62 - 1.15	1.07 - 1.27	1 - 1.43	0.93 - 1.21	26.26 - 63.83
2010 coastal context - Cap ecosystem take	0.38 - 5.13	0.65 - 30.16	1.03 - 1.14	0.88 - 1.1	1.84 - 2.2	1.96 - 2.34	10.11 - 20.84
2010 coastal context - Centralised mgmt.	0.28 - 5.13	0.39 - 30.79	0.54 - 1.06	0.88 - 1.16	1.84 - 3.44	2.15 - 2.43	10.11 - 20.82
2010 coastal context - FewMPA	0.21 - 5.07	0.23 - 16.05	0.56 - 1.1	0.89 - 1.17	1.86 - 3.46	2.21 - 2.49	10.11 - 20.88
2010 coastal context - Fragmented mgmt	0.28 - 5.13	0.38 - 31.1	0.54 - 1.06	0.89 - 1.16	1.85 - 3.45	2.14 - 2.43	10.11 - 20.82
2010 coastal context - ManyMPA	0.29 - 5.14	0.46 - 37.86	0.53 - 1.05	0.87 - 1.15	1.83 - 3.42	2.12 - 2.39	10.11 - 20.78
2010 coastal context - Seasons	0.29 - 5.13	0.48 - 34.83	0.53 - 1.05	0.87 - 1.15	1.83 - 3.41	2.12 - 2.39	10.11 - 20.79
2010 coastal context - SlowAssess	0.28 - 5.13	0.38 - 30.56	0.54 - 1.06	0.89 - 1.17	1.24 - 3.46	2.15 - 2.77	10.13 - 20.83
2010 coastal context - Integrated Mgmt (IM)	0.26 - 16.39	0.65 - 51.73	0.51 - 1.12	0.97 - 1.27	0.81 - 2.27	1.01 - 1.27	10.96 - 15.59
Cumulative impacts - 2010 Status Quo (SQ)	0.23 - 5.09	0.22 - 15.98	0.58 - 1.15	0.92 - 1.21	1.9 - 3.55	2.34 - 2.64	10.12 - 20.98
Cumulative impacts - Cap ecosystem take	0.47 - 5.09	0.35 - 16.23	1.11 - 1.22	0.92 - 1.15	1.9 - 2.26	2.13 - 2.55	10.12 - 20.96
Cumulative impacts - Centralised mgmt.	0.24 - 5.09	0.22 - 16.44	0.58 - 1.14	0.92 - 1.21	1.9 - 3.53	2.32 - 2.63	10.12 - 20.94
Cumulative impacts - FewMPA	0.17 - 5.04	0.2 - 12.28	0.59 - 1.18	0.93 - 1.22	1.93 - 3.55	2.39 - 2.69	10.12 – 30.9
Cumulative impacts - Fragmented mgmt	0.24 - 5.09	0.22 - 16.52	0.58 - 1.14	0.93 - 1.21	1.92 - 3.54	2.32 - 2.63	10.12 - 20.94
Cumulative impacts - ManyMPA	0.24 - 5.1	0.23 - 17.42	0.57 - 1.13	0.92 - 1.19	1.9 - 3.51	2.29 - 2.59	10.12 - 20.9
Cumulative impacts - Seasons	0.24 - 5.09	0.23 - 17.05	0.57 - 1.13	0.92 - 1.19	1.9 - 3.5	2.3 - 2.59	10.12 - 20.9

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Cumulative impacts - SlowAssess	0.23 - 5.09	0.22 - 16.44	0.58 - 1.14	0.93 - 1.21	1.28 - 3.55	2.32 - 3.02	10.14 - 20.95
Cumulative impacts - IM	0.23 - 16.3	0.41 - 31.98	0.54 - 1.2	1.02 - 1.32	0.84 - 2.33	1.11 - 1.38	11 - 13.66
Expanded LTL fishery - IM	0.29 - 5.13	0.4 - 31.87	0.54 - 1.06	0.88 - 1.16	1.84 - 3.45	2.14 - 2.42	10.11 - 12.86
New mesopelgic fishery - IM	0.29 - 5.13	0.4 - 31.87	0.54 - 1.06	0.87 - 1.16	1.83 - 3.45	2.14 - 2.42	10.11 - 12.86
Extreme climate events - IM	0.28 - 5.12	0.38 - 29.14	0.54 - 1.07	0.88 - 1.16	1.84 - 3.45	2.16 - 2.43	10.11 - 12.86
Blooms - IM	0.28 - 5.12	0.38 - 29.33	0.54 - 1.07	0.88 - 1.16	1.84 - 3.44	2.16 - 2.43	10.11 - 12.86
Primary production regime shift - IM	0.28 - 5.76	0.37 - 56.99	0.54 - 1.06	0.88 - 1.16	1.37 - 3.45	2.34 - 2.55	10.11 - 13.24
Fish kills - IM	0.28 - 5.13	0.37 - 29.87	0.54 - 1.07	0.88 - 1.17	1.84 - 3.46	2.16 - 2.44	10.11 - 12.85
Range extensions - IM	0.28 - 5.13	0.39 - 29.38	0.54 - 1.07	0.88 - 1.16	1.84 - 3.44	2.16 - 2.43	10.11 - 12.85
Gear switching allowed - IM	0.29 - 5.13	0.48 - 34.78	0.53 - 1.05	0.87 - 1.15	1.83 - 3.42	2.12 - 2.39	10.11 - 12.79
High compliance - IM	0.28 - 5.13	0.36 - 31.34	0.54 - 1.06	0.88 - 1.17	1.84 - 3.46	2.14 - 2.45	10.11 - 12.82
Low Compliance - IM	0.28 - 5.12	0.38 - 29.02	0.54 - 1.07	0.89 - 1.17	1.86 - 3.46	2.17 - 2.44	10.11 - 12.87
Flexible fisher behaviour - IM	0.29 - 5.13	0.39 - 30.8	0.54 - 1.06	0.88 - 1.16	1.84 - 3.44	2.15 - 2.42	10.11 - 12.83
Increased fishing pressure drivers - IM	0.28 - 5.13	0.37 - 29.31	0.54 - 1.07	0.88 - 1.17	1.84 - 3.46	2.16 - 2.44	10.11 - 12.86
High Cost, Low Values - IM	0.29 - 5.14	0.51 - 36.69	0.53 - 1.06	0.87 - 1.15	1.83 - 3.41	2.12 - 2.39	10.11 - 12.78
Low Costs, High Values - IM	0.63 - 5.13	0.9 - 31.01	1.03 - 1.74	0.88 - 1.07	0.94 - 2.04	1.49 - 2.34	10.05 - 12.83
Standard Markets - IM	0.28 - 5.13	0.37 - 29.31	0.54 - 1.07	0.88 - 1.17	1.84 - 3.46	2.16 - 2.44	10.11 - 12.86
Technology Creep - IM	0.29 - 5.13	0.43 - 32.27	0.53 - 1.06	0.88 - 1.15	1.83 - 3.42	2.13 - 2.4	10.11 - 12.8
No Acclimation - 2010 coastal context - IM	0.12 - 2.39	0.26 - 19.89	0.82 - 0.99	0.96 - 1.01	0.94 - 1.59	0.98 - 1.05	10.06 - 20.91
No Acclimation - Cumulative impacts - SQ	0.16 - 0.81	0.15 - 12.7	0.87 - 1.13	0.88 - 1.02	1.98 - 2.42	1.76 - 2.5	10.01 - 40.58

Table 10: Range of change in broad classes of functional groups in Atlantis SE under the RCP 8.5 emissions scenario

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
No Climate change - 2010 context - SQ	0.9 - 4.14	1.19 - 2.33	0.94 - 3.05	1.15 - 1.77	0.33 - 2.88	1.24 - 7.51	0.85 - 2.03
2010 coastal context - Cap ecosystem take	0.67 - 0.9	0.74 - 0.98	0.58 - 1.13	4.96 - 7.76	3.29 - 5.49	1.04 - 1.24	0.26 - 10501.51
2010 coastal context - Centralised mgmt.	0.95 - 1.27	0.83 - 1.34	0.99 - 1.16	4.79 - 7.79	1.66 - 3.83	1.16 - 1.45	0.19 - 0.46
2010 coastal context - FewMPA	0.39 - 0.91	0.64 - 0.99	0.69 - 0.93	2.36 - 2.94	1.53 - 3.12	0.89 - 1.17	0 - 528.87
2010 coastal context - Fragmented mgmt	0.85 - 1.26	0.75 - 1.33	0.98 - 1.11	1.66 - 4.57	2.6 - 3.36	1.08 - 1.37	0.17 - 0.44
2010 coastal context - ManyMPA	1.56 - 2.1	1.2 - 1.43	1.11 - 1.17	1.79 - 2.16	1.76 - 3.89	1.04 - 1.14	2.34 - 2.38
2010 coastal context - Seasons	1.04 - 2.07	1.32 - 1.54	1.14 - 1.16	1.91 - 2.02	1.52 - 3.84	0.94 - 1.2	2.34 - 2.37
2010 coastal context - SlowAssess	0.76 - 1.93	1.01 - 1.31	0.95 - 1.36	3.15 - 9.75	2.15 - 4.64	0.83 - 1.36	0.06 - 2.39
2010 coastal context - Integrated Mgmt (IM)	0.9 - 2.26	0.61 - 1.62	1.03 - 1.65	3.08 - 10.82	3.02 - 3.81	2.09 - 7.58	1 - 180.31
Cumulative impacts - 2010 Status Quo (SQ)	0.54 - 1.2	0.89 - 1.29	0.74 - 0.91	2.92 - 12.54	5.16 - 3.88	0.8 - 1.23	0 - 0.01
Cumulative impacts - Cap ecosystem take	0.31 - 1.23	0.74 - 1.29	0.47 - 0.92	1.08 - 21.14	7.06 -5.86	0.68 - 1.19	0 - 17.24
Cumulative impacts - Centralised mgmt.	0.59 - 1.3	0.94 - 1.33	0.8 - 0.95	0.96 - 16.77	4.83 - 4.5	0.81 - 1.39	0 - 186.66
Cumulative impacts - FewMPA	0.18 - 1.24	0.6 - 1.51	0.51 - 0.75	0.5 - 2.29	5.72 - 3.9	0.76 - 1.13	0 - 0.05
Cumulative impacts - Fragmented mgmt	0.58 - 1.2	0.94 - 1.32	0.8 - 0.88	0.56 - 12.83	6.39 - 3.62	0.78 - 1.44	0 - 0.16
Cumulative impacts - ManyMPA	0.97 - 2.36	1.13 - 1.97	0.85 - 0.94	0.36 - 1.69	5.67 - 3.64	0.68 - 1.15	0 - 2.31
Cumulative impacts - Seasons	0.71 - 2.38	1.29 - 2.02	0.83 - 0.94	0.39 - 1.49	5.71 - 3.54	0.63 - 1.15	0 - 233.25
Cumulative impacts - SlowAssess	0.42 - 2.63	0.95 - 1.61	0.77 - 1.1	0.63 - 7.6	5.89 - 4.94	0.54 - 1.43	0 - 0.01
Cumulative impacts - IM	0.56 - 3.08	0.61 - 2.47	0.84 - 1.2	0.52 - 8.43	3.05 - 3.01	1.36 - 7.93	0 - 1.78
Expanded LTL fishery - IM	0.83 - 1.32	0.73 - 1.29	1.03 - 1.18	3.4 - 16.18	2.31 - 4.52	0.8 - 1.04	0.33 - 0.64
New mesopelgic fishery - IM	0.83 - 1.32	0.74 - 1.29	1.03 - 1.22	1.4 - 10.74	2.31 - 4.83	0.8 - 1.06	0.33 - 1.79
Extreme climate events - IM	0.68 - 1.33	0.77 - 1.31	0.97 - 1.12	7.87 - 24.73	1.51 - 3.33	0.87 - 1.25	0.09 - 0.33
Blooms - IM	0.73 - 1.34	0.74 - 1.34	0.99 - 1.08	8.73 - 37.31	2.02 - 3.77	0.72 - 1.29	0.12 - 0.21
Primary production regime shift - IM	0.87 - 1.58	0.74 - 1.32	0.96 - 1.37	7.56 - 28.19	1.12 - 3.17	0.76 - 1.11	0.1 - 2.04
Fish kills - IM	0.85 - 1.16	0.74 - 1.3	0.94 - 1.1	5.24 - 25.28	1.08 - 3.93	1.08 - 1.24	0.07 - 0.3
Range extensions - IM	0.82 - 1.31	0.96 - 1.32	1.01 - 1.05	7.11 - 22.77	1.95 - 3.98	1.03 - 1.59	0.19 - 0.45
Gear switching allowed - IM	1.93 - 2.04	1.37 - 1.55	1.11 - 1.14	2.28 - 12.04	1.08 - 3.86	0.95 - 1.06	2.32 - 2.34
High compliance - IM	0.75 - 0.95	0.73 - 1.26	0.91 - 1.16	3.91 - 22.77	2.61 - 4.43	0.95 - 1.59	0.02 - 0.49

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Squid
Low Compliance - IM	0.55 - 0.91	0.7 - 1.52	0.98 - 1.03	21.51 - 25.06	2.17 - 3.62	0.91 - 1	0.01 - 0.08
Flexible fisher behaviour - IM	0.82 - 1.55	0.81 - 1.36	0.97 - 1.09	0.79 - 19	1.03 - 2.22	0.99 - 1.3	0.34 - 0.48
Increased fishing pressure drivers - IM	0.8 - 1.16	0.74 - 1.3	0.94 - 1.12	4.61 - 25.94	1.08 - 3.11	1.08 - 1.23	0.07 - 0.36
High Cost, Low Values - IM	1.59 - 1.83	1.21 - 1.39	1.16 - 1.17	1.64 - 1.83	2.35 - 3.32	0.79 - 1.21	2.35 - 2.4
Low Costs, High Values - IM	0.18 - 0.92	0.19 - 1.01	0.21 - 1.13	0.89 - 21.99	3.48 – 8.1	0.86 - 1.41	0.4 - 3500.95
Standard Markets - IM	0.8 - 1.16	0.74 - 1.3	0.94 - 1.12	14.61 - 25.94	1.18 - 3.11	1.08 - 1.23	0.07 - 0.36
Technology Creep - IM	1.3 - 1.78	0.87 - 1.23	1.25 - 1.29	3.43 - 3.77	2.92 - 3.11	0.99 - 1.54	1.37 - 2.1
No Acclimation - 2010 coastal context - IM	0.19 - 0.83	0.14 - 0.56	0.1 - 0.72	1.03 - 4.89	0.73 - 1.3	1.05 - 2.23	0.08 - 211.36
No Acclimation - Cumulative impacts - SQ	0.18 - 0.74	0.29 - 0.38	0.07 - 0.64	1.42 - 56.6	1.02 - 2.02	0.16 - 0.87	0 - 0.08

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	0.61 - 0.69	1 - 1.32	0.62 - 1.15	1.07 - 1.27	1 - 1.43	0.93 - 1.21	26.26 - 63.83
2010 coastal context - Cap ecosystem take	0.29 - 0.42	0.68 - 1.07	1.08 - 2.29	1.03 - 1.08	1.35 - 2.11	1.77 - 2.18	10.91 - 43.01
2010 coastal context - Centralised mgmt.	0.29 - 0.3	0.65 - 0.7	1.07 - 1.08	1.08 - 1.08	2.1 - 2.11	2.17 - 2.19	20.99 - 43.01
2010 coastal context - FewMPA	0.21 - 0.22	0.41 - 0.41	1.11 - 1.11	1.09 - 1.09	2.12 - 2.13	2.23 - 2.24	30.04 - 43.05
2010 coastal context - Fragmented mgmt	0.29 - 0.3	0.65 - 0.7	1.07 - 1.08	1.08 - 1.08	2.11 - 2.12	2.17 - 2.19	20.98 - 43.02
2010 coastal context - ManyMPA	0.3 - 0.31	0.74 - 0.83	1.07 - 1.07	1.07 - 1.07	2.09 - 2.1	2.15 - 2.15	20.94 - 42.95
2010 coastal context - Seasons	0.3 - 0.31	0.76 - 0.8	1.07 - 1.07	1.07 - 1.07	2.09 - 2.09	2.15 - 2.15	20.94 - 42.95
2010 coastal context - SlowAssess	0.29 - 0.39	0.64 - 1.25	1.07 - 1.09	1.08 - 1.09	1.41 - 2.12	2.18 - 2.58	20.99 - 43.42
2010 coastal context - Integrated Mgmt (IM)	0.31 - 0.47	0.98 - 1.28	1.02 - 1.13	1.08 - 1.19	0.93 - 1.39	0.94 - 1.22	10.02 - 26.91
Cumulative impacts - 2010 Status Quo (SQ)	0.24 - 0.25	0.41 - 0.41	1.16 - 1.16	1.13 - 1.13	2.18 - 2.18	2.37 - 2.38	30.15 - 53.17
Cumulative impacts - Cap ecosystem take	0.24 - 0.5	0.41 - 0.67	1.15 - 2.44	1.07 - 1.13	1.38 - 2.18	1.91 - 2.38	20.45 - 53.17
Cumulative impacts - Centralised mgmt.	0.25 - 0.26	0.41 - 0.42	1.15 - 1.16	1.12 - 1.13	2.16 - 2.18	2.36 - 2.37	30.11 - 53.16
Cumulative impacts - FewMPA	0.18 - 0.19	0.33 - 0.34	1.19 - 1.2	1.14 - 1.14	2.18 - 2.21	2.42 - 2.44	30.17 - 53.21
Cumulative impacts - Fragmented mgmt	0.24 - 0.26	0.41 - 0.43	1.15 - 1.17	1.12 - 1.14	2.17 - 2.19	2.35 - 2.39	30.11 - 53.19
Cumulative impacts - ManyMPA	0.25 - 0.26	0.43 - 0.44	1.14 - 1.15	1.11 - 1.12	2.15 - 2.17	2.33 - 2.35	30.07 - 53.11
Cumulative impacts - Seasons	0.25 - 0.26	0.43 - 0.44	1.14 - 1.15	1.11 - 1.12	2.15 - 2.17	2.33 - 2.35	30.07 - 53.11

Scenario	Bivalves	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Cumulative impacts - SlowAssess	0.25 - 0.32	0.41 - 0.74	1.15 - 1.16	1.12 - 1.14	1.47 - 2.18	2.36 - 2.82	30.12 - 53.62
Cumulative impacts - IM	0.27 - 0.36	0.65 - 0.9	1.09 - 1.21	1.12 - 1.24	0.96 - 1.43	1.03 - 1.32	10.06 - 28.44
Expanded LTL fishery - IM	0.3 - 0.31	0.67 - 0.72	1.07 - 1.08	1.08 - 1.08	2.1 - 2.12	2.17 - 2.18	13.02 - 30.05
New mesopelgic fishery - IM	0.3 - 0.31	0.67 - 0.76	1.07 - 1.08	1.07 - 1.08	2.1 - 2.12	2.17 - 2.18	13.01 - 30.05
Extreme climate events - IM	0.29 - 0.3	0.64 - 0.69	1.08 - 1.08	1.08 - 1.09	2.1 - 2.12	2.18 - 2.19	23.2 - 30.03
Blooms - IM	0.29 - 0.3	0.65 - 0.68	1.08 - 1.08	1.08 - 1.08	2.11 - 2.12	2.18 - 2.19	33.01 - 30.03
Primary production regime shift - IM	0.29 - 0.93	0.63 - 1.28	1.07 - 1.08	1.08 - 1.09	1.41 - 2.12	2.18 - 2.59	23.01 - 30.42
Fish kills - IM	0.29 - 0.3	0.63 - 0.69	1.08 - 1.08	1.08 - 1.09	2.1 - 2.12	2.18 - 2.2	13 .2- 30.03
Range extensions - IM	0.3 - 0.31	0.66 - 0.68	1.08 - 1.08	1.08 - 1.08	2.1 - 2.11	2.18 - 2.19	12.99 - 30.02
Gear switching allowed - IM	0.3 - 0.31	0.76 - 0.78	1.06 - 1.07	1.07 - 1.07	2.09 - 2.1	2.15 - 2.15	12.95 - 20.95
High compliance - IM	0.29 - 0.3	0.61 - 0.71	1.07 - 1.09	1.07 - 1.09	2.1 - 2.12	2.17 - 2.21	12.98 - 30.05
Low Compliance - IM	0.28 - 0.3	0.64 - 0.66	1.08 - 1.1	1.09 - 1.09	2.11 - 2.13	2.2 - 2.22	13.03 - 30.06
Flexible fisher behaviour - IM	0.3 - 0.3	0.66 - 0.7	1.07 - 1.08	1.08 - 1.08	2.1 - 2.11	2.18 - 2.18	12.99 – 30.8
Increased fishing pressure drivers - IM	0.29 - 0.3	0.63 - 0.7	1.08 - 1.08	1.08 - 1.09	2.1 - 2.12	2.18 - 2.2	13.1 - 30.03
High Cost, Low Values - IM	0.3 - 0.31	0.79 - 0.8	1.07 - 1.07	1.07 - 1.07	2.09 - 2.09	2.15 - 2.15	12.94 - 2.95
Low Costs, High Values - IM	0.29 - 0.76	0.69 - 1.52	1.07 - 3.49	0.97 - 1.08	0.58 - 2.1	1.34 - 2.18	10.79 – 30.4
Standard Markets - IM	0.29 - 0.3	0.63 - 0.7	1.08 - 1.08	1.08 - 1.09	2.1 - 2.12	2.18 - 2.2	13.9 - 30.03
Technology Creep - IM	0.3 - 0.31	0.7 - 0.75	1.07 - 1.07	1.07 - 1.07	2.09 - 2.1	2.16 - 2.16	12.95 - 20.96
No Acclimation - 2010 coastal context - IM	0.13 - 0.16	0.44 - 0.68	1 - 1.64	0.89 - 1.24	0.97 - 1.13	0.93 - 0.99	10.92 - 124.22
No Acclimation - Cumulative impacts - SQ	0.13 - 0.15	0.26 - 0.3	0.96 - 1.75	0.82 - 1.18	1.48 - 2.63	1.79 - 2.33	10.11 - 200.85

cases) but is also not as strong under RCP 8.5, in part because the prey field has not increased as strongly, but also because physiological effects of temperature shifts and ocean acidification are stronger. The seabirds show more variation, often declining under RCP 3 (except when integrated management is in place), increasing under RCP 4.5 and remaining fairly stable under RCP 8.5. Good management allows for increases in sharks and mammals regardless of emission scenario, though that is most likely because we do not yet fully appreciate potential mechanisms beyond shifts in prey fields and the spatial distribution of preferred water column properties. For the bivalves and crustaceans the degree of vulnerability to ocean acidification dictates the outcome. If vulnerability is low then biomasses can increase in response to the faster growth rates possible under the higher temperatures and more abundant forage fields, but declines (by as much as 30-70%) are more often seen – either as a result of increased predation or as a direct result of negative physiological outcomes (this is particularly the case under RCP 8.5). In contrast the soft body infauna tend to increase in line with increased detrital and microbial pools. Jellyfish show only moderate shifts across the scenarios and strategies (typically less than doubling), but are a strong marker of systems under climate stress, increasing in all cases under RCP 8.5. The most variable group was squid, which was very much boom or bust. While this group was relatively stable without climate change, it potentially changed by orders of magnitude even under RCP 3, becoming more extreme under the higher emissions scenarios. If conditions remained favourable for squid (environmentally and trophically) through the course of a simulation the relative biomass could increase by 1000x or more (though more often by <5x). However, if multiple years of unfavourable conditions occurred (high temperatures around spawning, shoaling of hypoxic layers in key locations etc.) then the population could collapse.

The relative composition of the macrofaunal biological communities under the various management strategies show the least change under RCP 3 when acclimation and evolution is allowed for (Figure 18), even then the contribution by demersal fish falls. The contribution by sharks decreases under cumulative impacts, but increases when integrated management is used. In contrast, the contribution by forage fish and invertebrates increases across the board, so long as acclimation is allowed for. In most cases the contribution by squid declines, except when there is no acclimation – where cephalopods dominate the ecosystem biomass. The composition under RCP 4.5 (Figure 19) shows much larger changes, with increased pelagic productivity seeing the system shift to one more characteristic of upwelling systems, dominated by forage fish and squid. This is a much stronger outcome than any management effects. The most even, least changed states are under integrated management, but even then the composition is still strongly skewed. Under RCP 8.5 (Figure 20) forage fish and squid can still make significant contributions to the overall biomass, however the system is generally more evenly constituted; although other pelagic fish and sharks make up much more of the biomass than the starting state.

In comparison with the “no climate change” case the most robust management strategies (i.e. show the least change in system state) are when there are extensive (30-75%) spatial or seasonal closures, either in large unified closures or even when composed of small closures spread across the entire model domain, or integrated management (especially when there are also high levels of compliance). This is in part because these forms of management see less structural change, particularly amongst the demersal groups. Nevertheless, even these management strategies are not immune to the large-scale pelagic shift seen under RCP 4.5.

Looking at the trajectories rather than end-points, within any one management strategy there is little divergence between the RCP cases until after 2030. At this point variability in the lower trophic levels (e.g. diatoms under integrated management, Figure 21) and forage species (e.g. squid under integrated management, Figure 22) begins to grow and the trajectories of finfish or higher trophic levels go from gradual change to steeper shifts (e.g. gulper sharks under integrated management, Figure 23). The key point in these shifts seems to be associated with atmospheric pCO_2 of 550 - 700ppm. All trajectories will be posted to the **sea**view website, but the trajectories of the average relative biomass for each of the group types are provided in Figures A.1 – A.15 under integrated management for each of the emission scenarios.

One of the most uncertain parts of the model is the representation of acclimation and evolution. Levels of acclimation and evolutionary change expressed in the model were different across groups and simulations

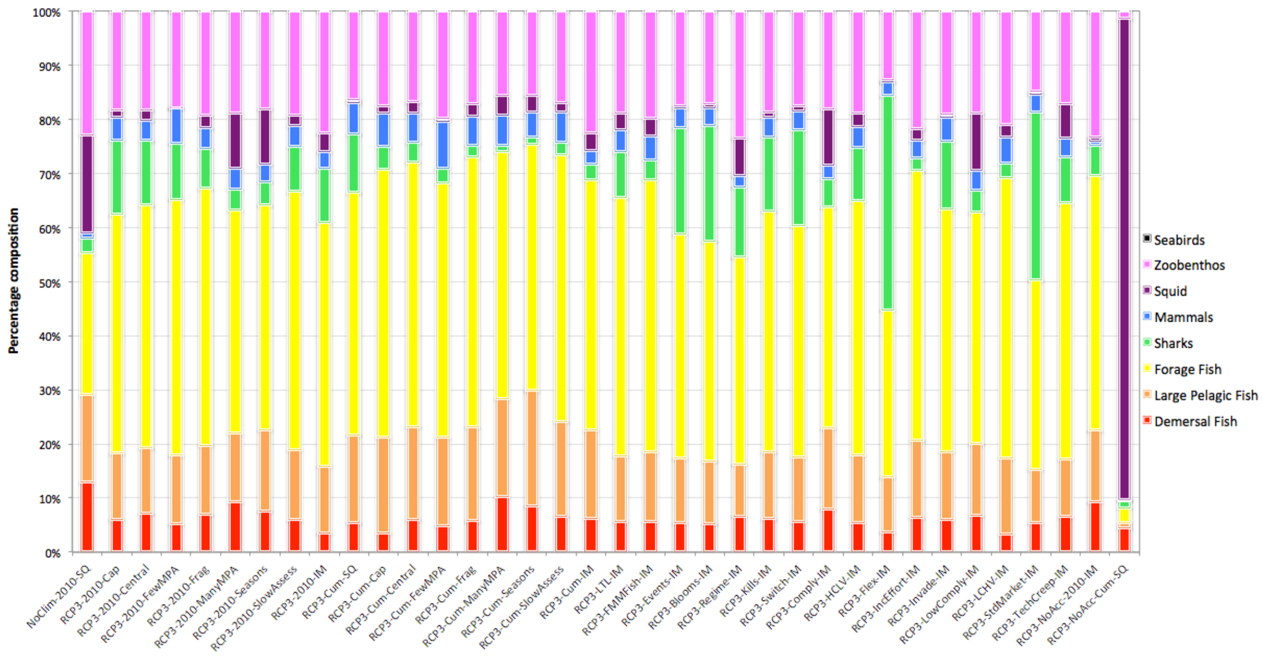


Figure 18: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SE under RCP 3

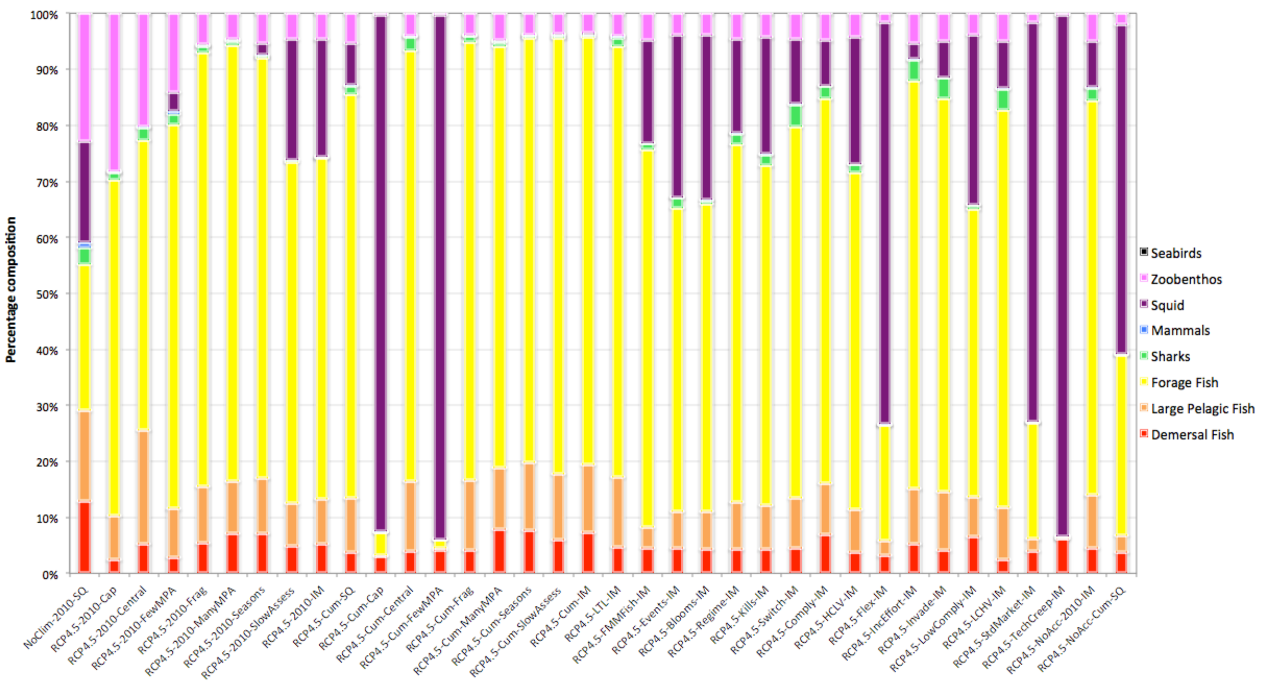


Figure 19: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SE under RCP 4.5

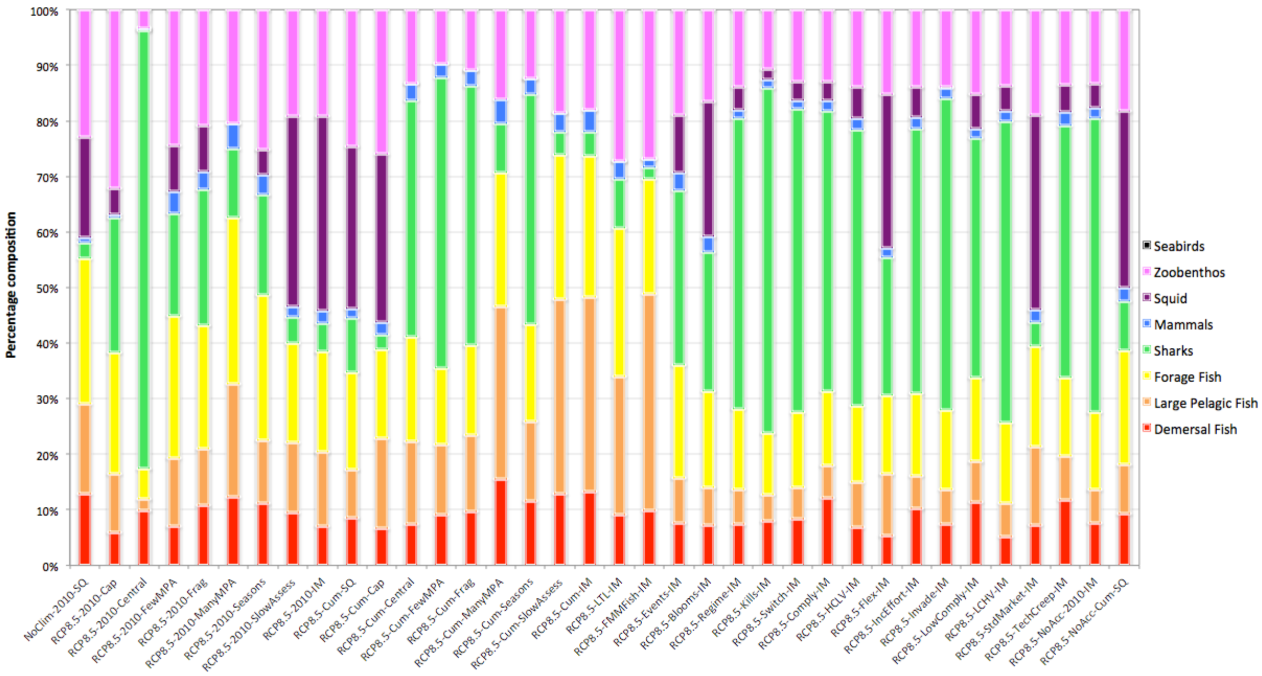


Figure 20: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SE under RCP 8.5

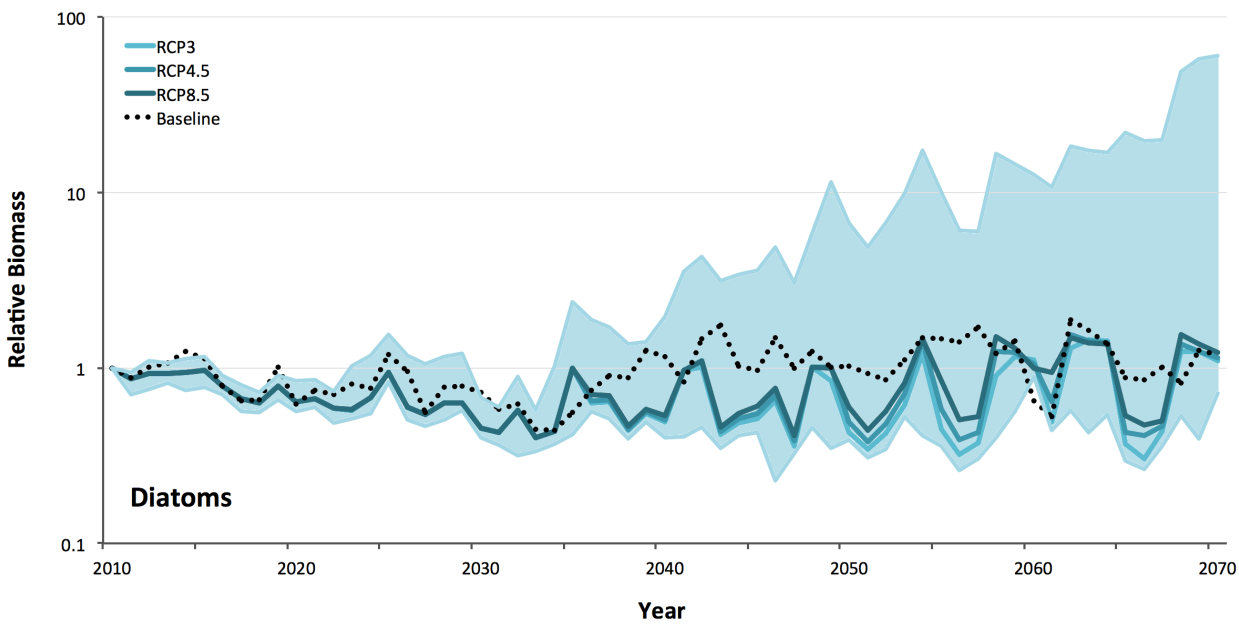


Figure 21: The average relative biomass of diatoms through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

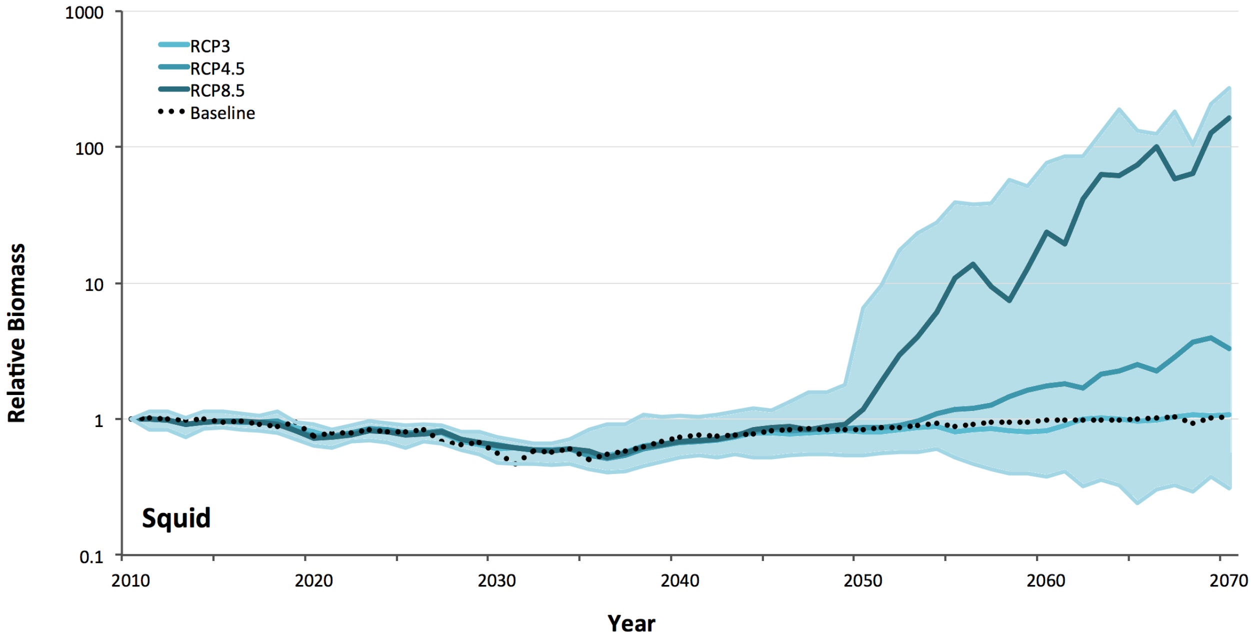


Figure 22: The average relative biomass of squid through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

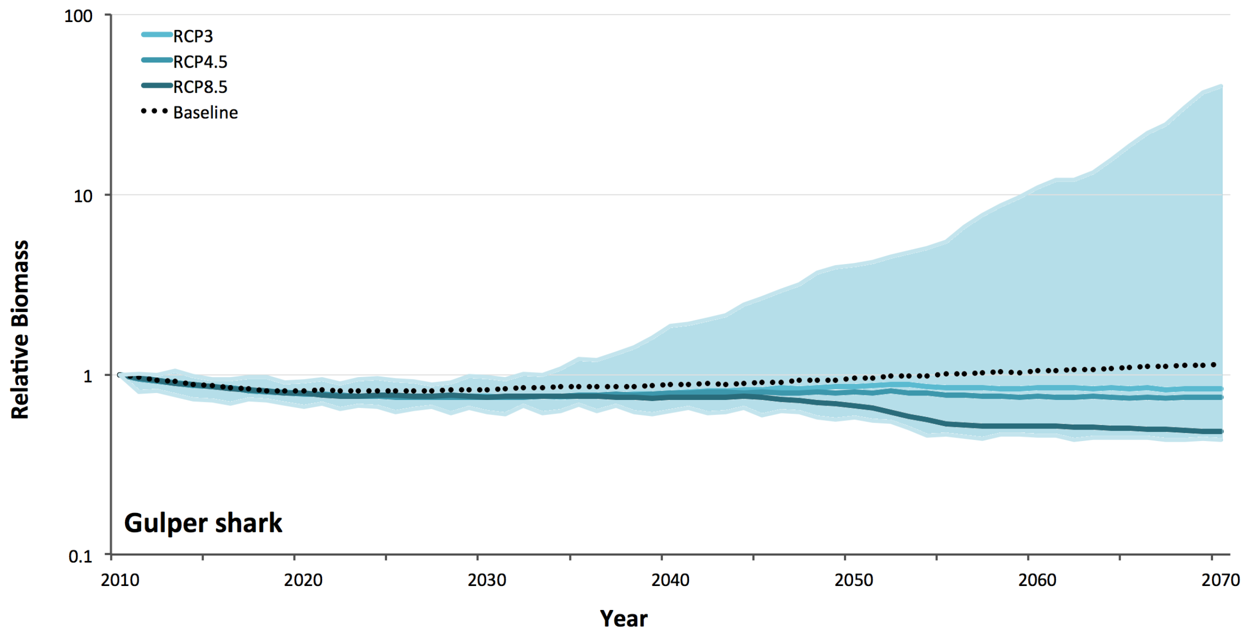


Figure 23: The average relative biomass of gulper sharks through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

depending on the “stress” experienced by that group under those conditions. If the degree of shifting in the parameter values for each group are rescaled to generational time scales for the species represented by the group then under RCP 3 rates of change are <0.1 standard deviations (SD) per generation, which is comparable with long time frame evolution in the fossil record (Gingerich 2009). The rate of change is much higher under more extreme climate change and ocean acidification – reaching 0.38-0.42 SD for some invertebrates and demersal finfish (e.g. flathead). While high this is again within the range seen under high selective pressure in both field and laboratory studies (Gingerich 2009).

CONSERVATION STATUS

In terms of the number of stocks that would be classified as vulnerable by regulatory bodies, the highest exposure was always when no acclimation was allowed for (where as many as 80% of groups would be classified as vulnerable or exposed). When evolution and acclimation is included in the model however, the proportion of groups that would rate as vulnerable is much lower (Figures 24-26). The upper bound is similar across RCP scenarios – at roughly 40-45% if fisheries and climate are the major perturbations, and slightly higher (up to 55%) under cumulative pressures. However’ the lower bound is quite variable across the emission and other scenarios. Under RCP 3 the lower bound is roughly 50-66% of the higher bound in most instances, whereas under RCP 4.5 the range is much larger – with the lower bound 30-50% of the upper bound. In comparison the values for vulnerable groups are much tighter for RCP 8.5, but this comes about largely via a truncation of the lower end of the ranges; most management strategies do see less than 45% of groups exposed or vulnerable, but the lower bound is 80-90% of the upper bound. In all cases the greatest variance when there are productivity regime shifts, more intensive potential fishing (as costs are low or value high) or when there is no acclimation or evolution.

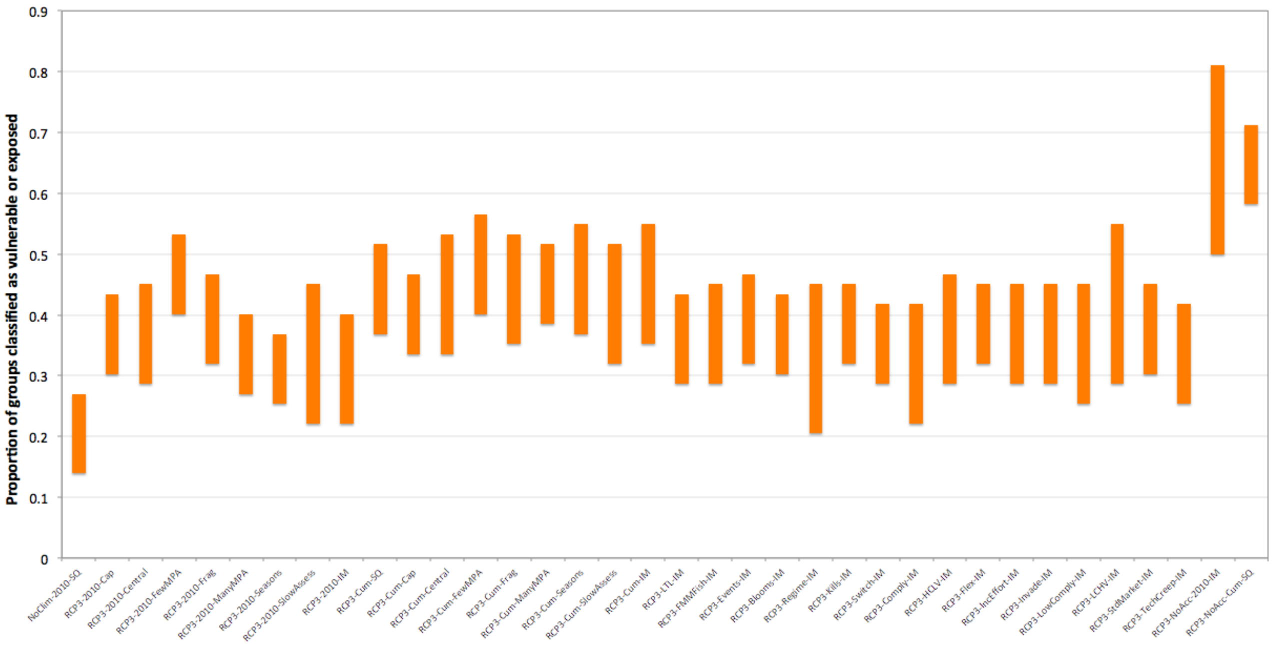


Figure 24: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SE under RCP 3

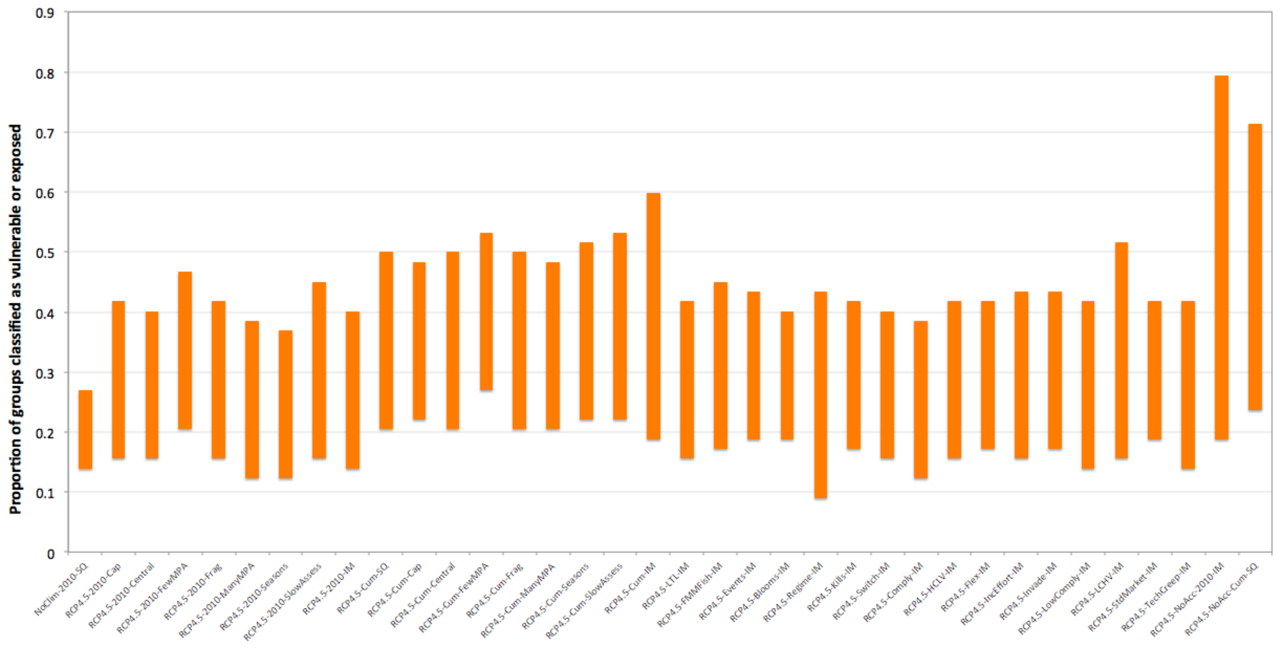


Figure 25: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SE under RCP 4.5

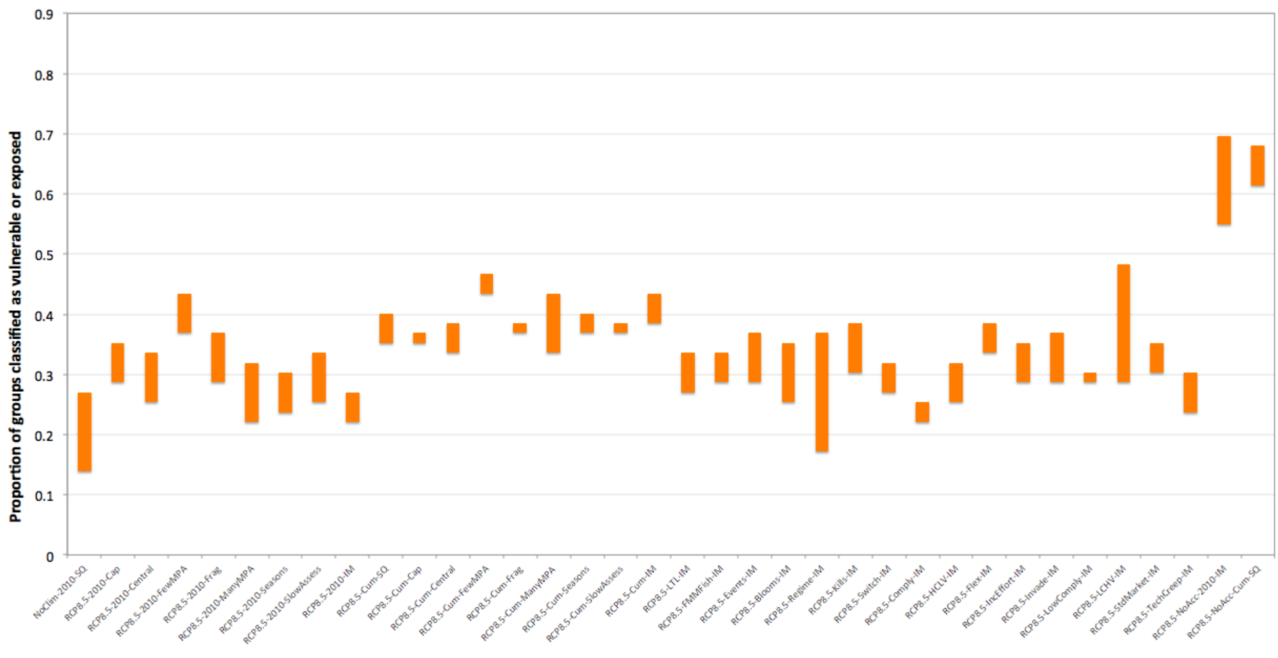


Figure 26: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SE under RCP 8.5

Similar patterns are seen within the biodiversity index (Figures 27-29). The maximum biodiversity seen under the different emissions scenarios is not drastically different – with high compliance, integrated management or productivity regime shifts all allowing for small (20% or less) increases in biodiversity. Some decrease in biodiversity was possible in all instances with cumulative impacts leading to a 10-40% drop in biodiversity. The variance in the outcomes dropped as emissions increased. Interestingly, the greatest potential drops in biodiversity were under the lower emission scenarios. With the more even compositions seen under RCP 8.5 leading to higher biodiversity statistics. Given the degree of shift in the parameterisation of function al groups however, there may well be a drop in richness – which may count more to regulatory bodies than an increase in evenness.

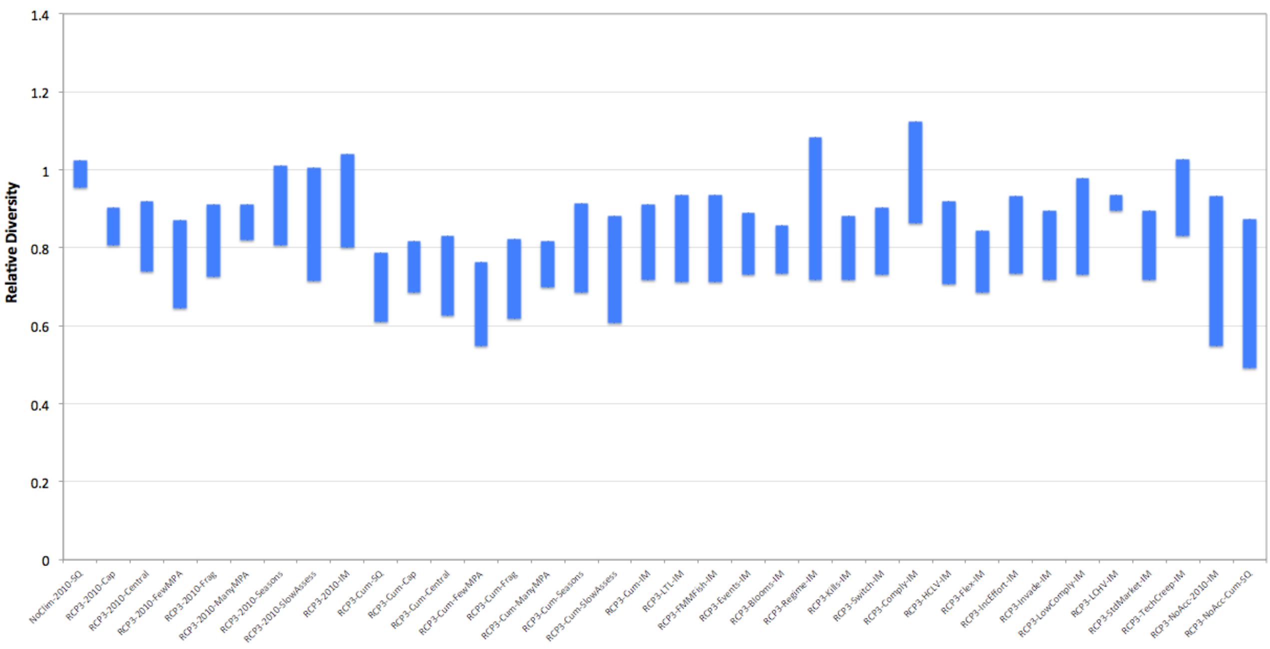


Figure 27: Range of relative marine biodiversity in 2065-2070 in Atlantis SE under RCP 3

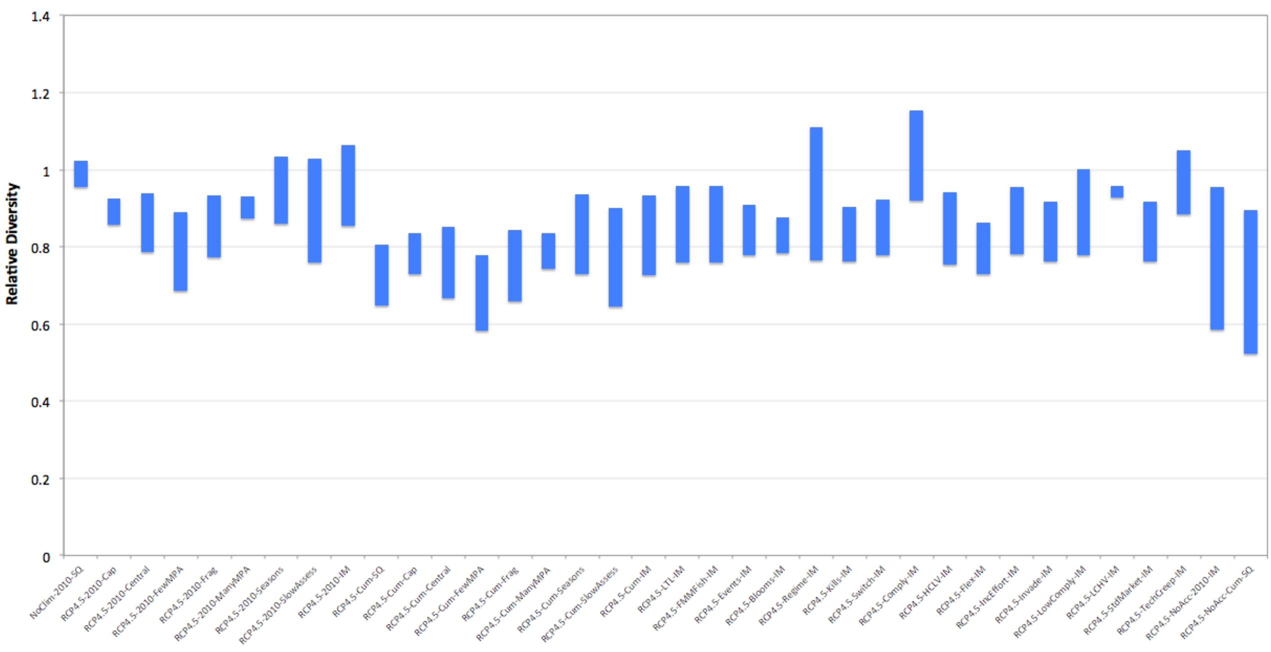


Figure 28: Range of relative marine biodiversity in 2065-2070 in Atlantis SE under RCP 4.5

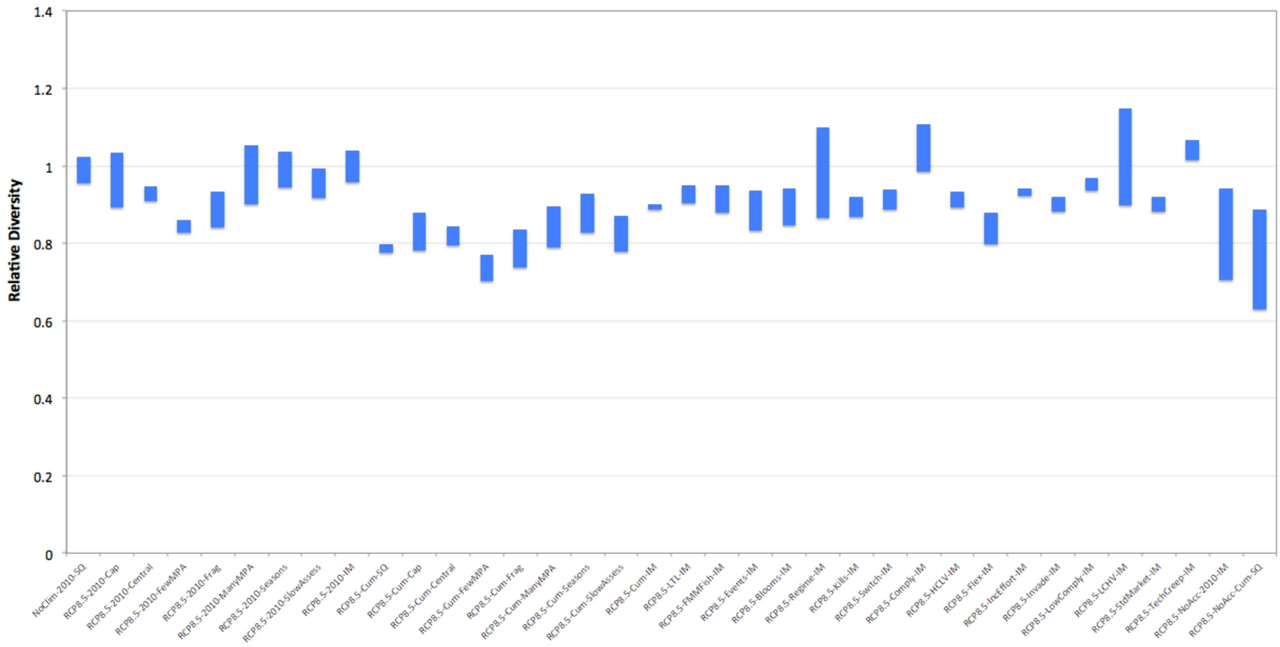


Figure 29: Range of relative marine biodiversity in 2065-2070 in Atlantis SE under RCP 8.5

Once again, in terms of performance against management objectives (whether fisheries stock status or conservation objectives) the most effective forms of management were extensive closures (often more temporal than large scale spatial closures) or integrated management (with extra gains possible when compliance rates were high). Increases in biodiversity were seen under improved technological efficiency and a strong truncation in potential reductions in biodiversity are seen when costs are low or value of product is high, but this is again due to evenness not necessarily richness. In these cases potential increases in biomass of high value (often large predatory) groups are not realised, as is the case when costs are low, or do not occur to the same degree as for more intensive management (this is the case for the technology creep scenario). In turn this means that prey species are not as impacted, their competitors likewise show much less change and overall the structure of the foodweb does not see as great a change and species contributions are more even (and thus the biodiversity index is higher). The proportion of groups rated as vulnerable (Figures 24-26) also indicates that these market and technology driven scenarios do not distinguish themselves with respect to other options when considered on these stock criteria rather than the biodiversity index.

SYSTEM INDICATORS

The mesopelagic fish biomass present in each simulation, in combination with growth in other pelagic groups in many simulations, sees the Altantis-SE system become more pelagically dominated under RCP3 and RCP 4.5 (Tables 11-13). The range extensions seen under RCP 8.5 and the reduction in mesopelagic biomass (as a result of predation pressure and shoaling of hypoxic waters) sees the pelagic:demersal biomass ratio shift back more to demersals under that emissions scenario. Increases in biomass of some target demersal fish stocks under extensive (spatial or temporal) closures or high compliance integrated management can see a shift in the system to one that is demersally dominated under RCP 3. It is also possible to see a collapse in pelagic productivity under cumulative effects and no acclimation, which sees the remaining demersal system dominate – this is an unlikely outcome however.

Southeast Australian ecosystems as represented in Atlantis-SE rely heavily on invertebrate prey sources, which is why the piscivore:planktivore fish biomass ratio for 2010 is 1.3. When the bivalves and crustacea are parameterised as vulnerable to climate change then this value can grow, with the effect increasing with worsening acidification (Tables 11-13). However, for RCP 3 and 4.5 under most parameterisations the more typical response is seen in this indicator – one where perturbation leads to a decline in the value of the

Table 11: Mean system indicators (± s.e.) for Atlantis SE (in 2065-2070) under the RCP 3 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	0.99 (± 0.03)	4.22 (± 2.02)	1.26 (± 0.23)	0.49 (± 0.07)	19.98 (± 3.14)
2010 coastal context - Cap ecosystem take	0.87 (± 0.06)	1.53 (± 0.76)	0.78 (± 0.52)	0.55 (± 0.13)	21.73 (± 2.8)
2010 coastal context - Centralised mgmt.	0.86 (± 0.1)	1.34 (± 0.6)	0.89 (± 0.71)	0.67 (± 0.1)	23.04 (± 2.56)
2010 coastal context - FewMPA	0.79 (± 0.12)	2.07 (± 1.14)	0.68 (± 0.53)	0.69 (± 0.18)	27.29 (± 4.64)
2010 coastal context - Fragmented mgmt	0.83 (± 0.09)	1.45 (± 0.78)	0.7 (± 0.49)	0.64 (± 0.11)	24.17 (± 3.22)
2010 coastal context - ManyMPA	0.88 (± 0.05)	0.89 (± 0.44)	0.74 (± 0.43)	0.4 (± 0.13)	17.68 (± 2.45)
2010 coastal context - Seasons	0.92 (± 0.1)	0.8 (± 0.28)	0.74 (± 0.45)	0.38 (± 0.13)	17.5 (± 2.57)
2010 coastal context - SlowAssess	0.88 (± 0.15)	1.55 (± 1.05)	0.7 (± 0.51)	0.66 (± 0.18)	24.86 (± 4.69)
2010 coastal context - Integrated Mgmt	0.92 (± 0.12)	6.55 (± 4.36)	0.75 (± 0.67)	0.35 (± 0.23)	15.33 (± 2.41)
Cumulative impacts - 2010 Status Quo	0.73 (± 0.1)	1.82 (± 1.06)	1.42 (± 1.58)	0.6 (± 0.13)	24.8 (± 4.92)
Cumulative impacts - Cap ecosystem take	0.76 (± 0.07)	1.95 (± 1.16)	1.9 (± 2.57)	0.43 (± 0.35)	20.44 (± 9.11)
Cumulative impacts - Centralised mgmt.	0.75 (± 0.11)	1.69 (± 0.95)	1.6 (± 2.04)	0.5 (± 0.2)	22.05 (± 6.22)
Cumulative impacts - FewMPA	0.69 (± 0.12)	2.87 (± 2.15)	0.86 (± 0.89)	0.67 (± 0.2)	27.64 (± 5.88)
Cumulative impacts - Fragmented mgmt	0.73 (± 0.1)	1.8 (± 1.07)	1.39 (± 1.73)	0.52 (± 0.18)	22.28 (± 5.5)
Cumulative impacts - ManyMPA	0.77 (± 0.06)	1.12 (± 0.66)	0.94 (± 0.81)	0.33 (± 0.27)	18 (± 6.58)
Cumulative impacts - Seasons	0.81 (± 0.12)	1.04 (± 0.61)	0.95 (± 0.84)	0.33 (± 0.27)	18.28 (± 6.88)
Cumulative impacts - SlowAssess	0.77 (± 0.15)	2.07 (± 1.5)	0.79 (± 0.71)	0.64 (± 0.15)	25.06 (± 4.04)
Cumulative impacts - IM	0.84 (± 0.1)	9.29 (± 10.08)	1.05 (± 1.27)	0.33 (± 0.3)	17.44 (± 6.43)
Expanded LTL fishery - IM	0.85 (± 0.12)	1.47 (± 0.89)	0.98 (± 0.95)	0.45 (± 0.14)	19.9 (± 3.56)
New mesopelgic fishery - IM	0.85 (± 0.12)	1.48 (± 0.88)	0.89 (± 0.91)	0.55 (± 0.11)	22.6 (± 2.92)
Extreme climate events - IM	0.81 (± 0.08)	1.56 (± 0.99)	1.78 (± 2.06)	0.69 (± 0.12)	25.26 (± 3.49)
Blooms - IM	0.81 (± 0.06)	1.5 (± 0.89)	2.49 (± 3.22)	0.71 (± 0.1)	23.86 (± 2.95)
Primary production regime shift - IM	0.89 (± 0.18)	1.18 (± 0.32)	1.93 (± 2.33)	0.61 (± 0.19)	23.11 (± 4.7)
Fish kills - IM	0.83 (± 0.09)	1.42 (± 0.67)	1.79 (± 2.19)	0.69 (± 0.13)	25.58 (± 3.97)
Range extensions - IM	0.84 (± 0.09)	1.42 (± 0.77)	1.84 (± 2.2)	0.63 (± 0.13)	23.74 (± 2.19)
Gear switching allowed - IM	1.01 (± 0.13)	0.79 (± 0.31)	1.32 (± 1.26)	0.4 (± 0.13)	18.15 (± 2.69)
High compliance - IM	0.84 (± 0.12)	1.65 (± 0.95)	1.55 (± 1.9)	0.65 (± 0.2)	22.7 (± 3.83)
Low Compliance - IM	0.78 (± 0.08)	2.05 (± 1.4)	2.17 (± 2.14)	0.69 (± 0.19)	22.68 (± 3.34)
Flexible fisher behaviour - IM	0.86 (± 0.11)	1.34 (± 0.8)	1.42 (± 1.75)	0.59 (± 0.04)	23.71 (± 1.39)
Increased fishing pressure drivers - IM	0.83 (± 0.1)	1.45 (± 0.73)	1.79 (± 2.2)	0.62 (± 0.2)	22.4 (± 3.93)
High Cost, Low Values - IM	0.88 (± 0.13)	0.95 (± 0.43)	0.73 (± 0.49)	0.35 (± 0.13)	16.75 (± 2.41)
Low Costs, High Values - IM	0.91 (± 0.02)	1.62 (± 0.79)	1.57 (± 1.96)	0.43 (± 0.24)	20.11 (± 5.4)
Standard Markets - IM	0.83 (± 0.1)	1.45 (± 0.73)	1.98 (± 2.09)	0.72 (± 0.13)	24.67 (± 3.52)
Technology Creep - IM	0.96 (± 0.11)	1.05 (± 0.6)	0.64 (± 0.4)	0.35 (± 0.09)	18.13 (± 1.82)
No Acclimation - 2010 coastal context - IM	0.8 (± 0.22)	1.78 (± 1.31)	0.91 (± 0.68)	0.71 (± 0.13)	24.28 (± 3.01)
No Acclimation - Cumulative impacts - SQ	0.69 (± 0.19)	0.54 (± 0.59)	5.62 (± 8.07)	0.46 (± 0.18)	19.12 (± 6.5)

Table 12: Mean system indicators (± s.e.) for Atlantis SE (in 2065-2070) under the RCP 4.5 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	0.99 (± 0.03)	4.22 (± 2.02)	1.26 (± 0.23)	0.49 (± 0.07)	19.98 (± 3.14)
2010 coastal context - Cap ecosystem take	0.9 (± 0.04)	3.75 (± 5.49)	0.88 (± 0.43)	0.38 (± 0.32)	19.22 (± 7.99)
2010 coastal context - Centralised mgmt.	0.89 (± 0.09)	3.2 (± 4.66)	1 (± 0.65)	0.39 (± 0.32)	19.07 (± 8)
2010 coastal context - FewMPA	0.81 (± 0.11)	4.82 (± 6.61)	0.75 (± 0.44)	0.39 (± 0.27)	20.51 (± 7.68)
2010 coastal context - Fragmented mgmt	0.86 (± 0.08)	3.64 (± 5.43)	0.79 (± 0.43)	0.38 (± 0.32)	19.25 (± 7.88)
2010 coastal context - ManyMPA	0.91 (± 0.03)	2.17 (± 3.19)	0.83 (± 0.35)	0.38 (± 0.34)	18.64 (± 7.97)
2010 coastal context - Seasons	0.96 (± 0.09)	1.77 (± 2.46)	0.83 (± 0.38)	0.35 (± 0.31)	18.68 (± 7.94)
2010 coastal context - SlowAssess	0.91 (± 0.14)	4.12 (± 6.05)	0.82 (± 0.46)	0.36 (± 0.3)	18.89 (± 7.7)
2010 coastal context - Integrated Mgmt	0.96 (± 0.11)	6.6 (± 5.01)	0.81 (± 0.65)	0.47 (± 0.15)	20.4 (± 3.13)
Cumulative impacts - 2010 Status Quo (SQ)	0.75 (± 0.09)	4.27 (± 5.84)	1.57 (± 1.55)	0.59 (± 0.03)	24.63 (± 2.76)
Cumulative impacts - Cap ecosystem take	0.79 (± 0.06)	4.49 (± 6.06)	2.07 (± 2.61)	0.43 (± 0.24)	20.82 (± 6.69)
Cumulative impacts - Centralised mgmt.	0.78 (± 0.1)	3.83 (± 5.14)	1.75 (± 2.05)	0.56 (± 0.09)	23.37 (± 3.91)
Cumulative impacts - FewMPA	0.71 (± 0.11)	5.94 (± 7.23)	0.93 (± 0.78)	0.57 (± 0.09)	24.89 (± 3.22)
Cumulative impacts - Fragmented mgmt	0.75 (± 0.09)	4.33 (± 6.01)	1.53 (± 1.73)	0.56 (± 0.06)	23.44 (± 3.43)
Cumulative impacts - ManyMPA	0.8 (± 0.05)	2.6 (± 3.52)	1.03 (± 0.72)	0.41 (± 0.33)	20.35 (± 8.39)
Cumulative impacts - Seasons	0.84 (± 0.1)	2.15 (± 2.7)	1.04 (± 0.75)	0.41 (± 0.33)	20.64 (± 8.77)
Cumulative impacts - SlowAssess	0.8 (± 0.13)	4.96 (± 6.66)	0.92 (± 0.66)	0.61 (± 0.12)	24.54 (± 3.08)
Cumulative impacts - IM	0.84 (± 0.1)	9.51 (± 8.07)	1.1 (± 1.24)	0.43 (± 0.35)	20.83 (± 9.03)
Expanded LTL fishery - IM	0.88 (± 0.11)	3.84 (± 5.79)	1.1 (± 0.93)	0.38 (± 0.32)	19.32 (± 8.09)
New mesopelgic fishery - IM	0.88 (± 0.1)	3.84 (± 5.79)	1.01 (± 0.89)	0.35 (± 0.3)	18.68 (± 7.9)
Extreme climate events - IM	0.84 (± 0.07)	4.15 (± 6.35)	1.95 (± 2.11)	0.39 (± 0.32)	19.42 (± 8.06)
Blooms - IM	0.84 (± 0.05)	3.9 (± 5.91)	2.7 (± 3.35)	0.41 (± 0.34)	19.24 (± 8.03)
Primary production regime shift - IM	0.92 (± 0.17)	2.49 (± 3.45)	2.12 (± 2.39)	0.41 (± 0.34)	19.31 (± 7.93)
Fish kills - IM	0.85 (± 0.08)	3.44 (± 5.05)	1.96 (± 2.25)	0.39 (± 0.32)	19.55 (± 8.22)
Range extensions - IM	0.87 (± 0.08)	3.59 (± 5.36)	2 (± 2.24)	0.4 (± 0.34)	19.98 (± 8.33)
Gear switching allowed - IM	1.04 (± 0.12)	1.78 (± 2.49)	1.46 (± 1.25)	0.39 (± 0.34)	19.25 (± 8.44)
High compliance - IM	0.87 (± 0.1)	4.22 (± 6.27)	1.72 (± 1.93)	0.4 (± 0.33)	19.08 (± 7.72)
Low Compliance - IM	0.81 (± 0.07)	5.54 (± 8.27)	2.37 (± 2.15)	0.41 (± 0.33)	18.9 (± 7.42)
Flexible fisher behaviour - IM	0.89 (± 0.1)	3.49 (± 5.31)	1.57 (± 1.78)	0.36 (± 0.3)	19.54 (± 8.18)
Increased fishing pressure drivers - IM	0.86 (± 0.08)	3.58 (± 5.29)	1.97 (± 2.25)	0.39 (± 0.32)	19.01 (± 7.68)
High Cost, Low Values - IM	0.91 (± 0.12)	2.21 (± 3.11)	0.8 (± 0.42)	0.32 (± 0.27)	18.16 (± 7.32)
Low Costs, High Values - IM	0.95 (± 0.02)	3.92 (± 5.69)	1.76 (± 1.97)	0.37 (± 0.32)	19.4 (± 8.23)
Standard Markets - IM	0.86 (± 0.08)	3.58 (± 5.29)	2.16 (± 2.12)	0.4 (± 0.33)	19.4 (± 8.16)
Technology Creep - IM	0.99 (± 0.09)	2.68 (± 3.95)	0.73 (± 0.36)	0.32 (± 0.28)	18.4 (± 7.42)
No Acclimation - 2010 coastal context - IM	0.83 (± 0.21)	2.18 (± 2.83)	1.02 (± 0.61)	0.39 (± 0.31)	19.31 (± 7.6)
No Acclimation - Cumulative impacts - SQ	0.71 (± 0.19)	1.75 (± 2.94)	6.16 (± 8.4)	0.35 (± 0.3)	17.7 (± 6.66)

Table 13: Mean system indicators (± s.e.) for Atlantis SE (in 2065-2070) under the RCP 8.5 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	0.99 (± 0.03)	4.22 (± 2.02)	1.26 (± 0.23)	0.49 (± 0.07)	19.98 (± 3.14)
2010 coastal context - Cap ecosystem take	0.95 (± 0.08)	1.15 (± 0.15)	2.25 (± 1.04)	0.48 (± 0.06)	21.03 (± 0.78)
2010 coastal context - Centralised mgmt.	0.93 (± 0.02)	1.03 (± 0.15)	2.05 (± 0.47)	0.56 (± 0.03)	21.64 (± 0.82)
2010 coastal context - FewMPA	0.85 (± 0.02)	1.5 (± 0.42)	1.58 (± 0.15)	0.46 (± 0.03)	22.19 (± 1.55)
2010 coastal context - Fragmented mgmt	0.9 (± 0.05)	1.09 (± 0.22)	1.54 (± 0.22)	0.49 (± 0.04)	21.58 (± 1.5)
2010 coastal context - ManyMPA	0.96 (± 0.08)	0.67 (± 0.09)	1.79 (± 0.26)	0.58 (± 0.02)	21.78 (± 1.01)
2010 coastal context - Seasons	1 (± 0.05)	0.63 (± 0.05)	1.77 (± 0.27)	0.56 (± 0.04)	21.62 (± 0.76)
2010 coastal context - SlowAssess	0.95 (± 0.04)	1.08 (± 0.39)	2.01 (± 0.82)	0.53 (± 0.01)	22.15 (± 0.64)
2010 coastal context - Integrated Mgmt	1.01 (± 0.04)	5.88 (± 3.95)	2 (± 0.59)	0.6 (± 0.01)	20.93 (± 3.91)
Cumulative impacts - 2010 Status Quo (SQ)	0.79 (± 0.01)	1.3 (± 0.44)	3 (± 1.07)	0.48 (± 0.03)	22.57 (± 2.11)
Cumulative impacts - Cap ecosystem take	0.83 (± 0.05)	1.38 (± 0.54)	3.23 (± 1.85)	0.38 (± 0.16)	19.97 (± 4.16)
Cumulative impacts - Centralised mgmt.	0.81 (± 0.02)	1.21 (± 0.41)	2.68 (± 1.44)	0.48 (± 0.06)	21.9 (± 2.75)
Cumulative impacts - FewMPA	0.74 (± 0.03)	2.01 (± 1.41)	1.81 (± 0.64)	0.46 (± 0.07)	22.65 (± 2.78)
Cumulative impacts - Fragmented mgmt	0.79 (± 0.05)	1.28 (± 0.43)	2.2 (± 1.31)	0.47 (± 0.06)	21.77 (± 2.59)
Cumulative impacts - ManyMPA	0.84 (± 0.05)	0.8 (± 0.3)	2.06 (± 0.63)	0.4 (± 0.2)	19.87 (± 4.98)
Cumulative impacts - Seasons	0.88 (± 0.05)	0.76 (± 0.34)	2.06 (± 0.68)	0.38 (± 0.22)	19.79 (± 5.79)
Cumulative impacts - SlowAssess	0.83 (± 0.05)	1.41 (± 0.86)	2.18 (± 0.85)	0.5 (± 0.06)	22.28 (± 1.99)
Cumulative impacts - IM	0.9 (± 0.01)	7.5 (± 7.12)	2.29 (± 1.41)	0.42 (± 0.28)	19.64 (± 6.06)
Expanded LTL fishery - IM	0.92 (± 0.02)	1.08 (± 0.26)	2.47 (± 1.25)	0.52 (± 0.01)	21.59 (± 0.53)
New mesopelgic fishery - IM	0.91 (± 0.03)	1.09 (± 0.26)	1.86 (± 0.67)	0.49 (± 0.06)	21.78 (± 1.75)
Extreme climate events - IM	0.88 (± 0.05)	1.15 (± 0.34)	3.34 (± 1.07)	0.51 (± 0.04)	22.05 (± 1.28)
Blooms - IM	0.88 (± 0.06)	1.11 (± 0.29)	4.03 (± 1.88)	0.53 (± 0.05)	21.22 (± 1.65)
Primary production regime shift - IM	0.96 (± 0.12)	0.95 (± 0.19)	4.16 (± 2.03)	0.51 (± 0.04)	21.76 (± 1.39)
Fish kills - IM	0.89 (± 0.03)	1.09 (± 0.17)	3.31 (± 1.35)	0.5 (± 0.03)	22.16 (± 1.64)
Range extensions - IM	0.91 (± 0.03)	1.06 (± 0.22)	3.25 (± 1.19)	0.52 (± 0.05)	22.51 (± 1.09)
Gear switching allowed - IM	1.04 (± 0.06)	0.61 (± 0.01)	2.46 (± 0.67)	0.58 (± 0.03)	22.23 (± 0.8)
High compliance - IM	0.91 (± 0.02)	1.21 (± 0.23)	3.43 (± 1.85)	0.54 (± 0.02)	21.56 (± 0.56)
Low Compliance - IM	0.84 (± 0.04)	1.44 (± 0.46)	4.63 (± 0.59)	0.53 (± 0.04)	20.57 (± 0.73)
Flexible fisher behaviour - IM	0.93 (± 0.01)	1 (± 0.28)	2.45 (± 1.21)	0.54 (± 0.02)	22.91 (± 0.9)
Increased fishing pressure drivers - IM	0.9 (± 0.02)	1.1 (± 0.19)	3.82 (± 1.93)	0.51 (± 0.03)	21.27 (± 1.23)
High Cost, Low Values - IM	0.95 (± 0.02)	0.71 (± 0.04)	1.66 (± 0.12)	0.52 (± 0.05)	20.41 (± 1.19)
Low Costs, High Values - IM	1 (± 0.13)	1.21 (± 0.13)	6.95 (± 7.88)	0.4 (± 0.13)	20.29 (± 2.65)
Standard Markets - IM	0.9 (± 0.02)	1.1 (± 0.19)	3.78 (± 0.56)	0.54 (± 0.02)	21.8 (± 1.26)
Technology Creep - IM	1.04 (± 0.03)	0.77 (± 0.14)	1.59 (± 0.2)	0.47 (± 0.06)	21.16 (± 1.53)
No Acclimation - 2010 coastal context - IM	0.86 (± 0.13)	1.87 (± 2.14)	2.27 (± 0.98)	0.54 (± 0.05)	21.77 (± 1.6)
No Acclimation - Cumulative impacts - SQ	0.74 (± 0.13)	0.39 (± 0.3)	7.86 (± 5.57)	0.3 (± 0.12)	17.45 (± 4.98)

index, showing that the system is shifting to small body sizes and faster turnover species. Under the more extreme conditions of RCP 8.5 the system has shifted back to one apparently more heavily dependent on invertebrate production – though that impression is exacerbated by the consumption of forage fish by the sharks and mammals, which (as noted above) make up a much larger proportion of the total biomass.

Mean potential longevity (MPL) of fish and sharks has not proved to be a particularly sensitive index in this modelling exercise. Under cumulative pressures or when there was no acclimation MPL declined by up to 5 years, though typically less than 18 months (Tables 11-13). More often MPL increased by 1-2 years, either as a result of improved stocks states (under good management or increased productivity) or because the community structure shifts to larger bodied groups as the relative contribution by forage species drops away (this is the case for most RCP 8.5 simulations).

The large fish index (LFI), which is the proportion of total biomass in fish (including sharks and rays) that are > 40cm in asymptotic length, increased in the majority of simulations under RCP 3 – except when there were cumulative pressures (Tables 11-13). In contrast, LFI falls by 25-35% under RCP 4.5 and holds relatively steady under RCP 8.5. The indicator also proves hard to interpret easily. For instance, biodiversity and individual stocks are strong under widespread spatial closures, however that is a strategy with some of the greatest drops in LFI. Nevertheless, where LFI is useful is as an index of recfishing satisfaction as it reflects trophy fish available for capture and correlates well with catch rates for those species.

LANDINGS

The landings of pelagic groups and chondrichthyans increases in most instances, but the results are more complicated for demersal and invertebrate groups (Tables A.4-A.6). Under high productivity, low vulnerability parameterisations the landings of groups like macrozoobenthos (e.g. lobster) and bivalves (e.g. oyster) can increase by >40%, though under many other parameterisations the landings can drop by > 40% instead. Looking at relative landings by class of organism variability across parameterisation dominates for large pelagic and demersal fish, which (Tables 14-16). Consistent increases in landings of demersal fish occurs under RCP 3 and 4.5 when there are seasonal closures or when there are few constraints on fishing access due to improved technological efficiencies, low compliance or little spatial management. Whereas consistent decreases in landings of demersal fish happens under cumulative pressures and status quo or fragmented management; extreme events, blooms or fish kills; flexible fisher behaviour; when there are low costs or high value product; or in the majority of cases under RCP 8.5. The landings of large pelagics (e.g. tuna) also show a lot of variability across parameterisations, however they consistently increase under RCP 4.5 when there are changed primary productivity conditions and under RCP 8.5 when there is either freer access to fish (when there is less spatial management, lower compliance or technology creep) or when the stock increases are high under extensive spatial management. Large pelagic landings consistently decreases under RCP 3 and 4.5 under many of the cumulative impacts scenarios; when the assessment cycle is slowed; there is no acclimation; or when stock states are depressed when costs of fishing are low and value of product high. Forage fish landings tend to decrease across the board (as their low value makes them unattractive), except when mesopelagic fisheries start – when there are substantial increases in forage fish landings as a result. The landings of sharks holds steady or increases in almost all cases. In contrast the landings of squid is driven by the volatility of the biomasses, increasing by orders of magnitude when the group blooms but stopping when squid collapses.

In terms of total biomass landed, there is much variation across parameterisations (Tables 14-16), as a result of the variation across individual groups. Total landings consistently increase in most cases under RCP 8.5 as a result of increases in landings of forage fish and chondrichthyans. Where there are consistent increases under other emissions scenarios there is either a shift in productivity (e.g. blooms, regime shifts); significant restructuring of the ecosystem to a squid dominated one; the introduction of a fishery for

Table 14: Range of relative landings (in 2065-2070) by class of organism for Atlantis SE under the RCP 3 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
No Climate change - 2010 context - SQ	0.69 - 2.51	0.92 - 1.54	0.34 - 2.37	1.21 - 2.72	0.18 - 9.19	0.26 - 1.51	1.22 - 2.11	1.39 - 1.84
2010 coastal context - Cap ecosystem take	0.3 - 1.37	0.26 - 1.41	0.04 - 0.47	1.19 - 5.82	0.28 - 8.8	0.29 - 2.12	0.61 - 1.35	0.67 - 1.19
2010 coastal context - Centralised mgmt.	0.55 - 1.55	0.27 - 2.02	0.04 - 0.47	1.07 - 4.67	0.01 - 20.56	0.29 - 2.12	0.61 - 1.34	0.78 - 1.82
2010 coastal context - FewMPA	1.13 - 12.01	0.96 - 4.12	0.03 - 0.3	1.43 - 2.27	0 - 154.37	0.25 - 1.81	0.44 - 0.74	4.81 - 7.82
2010 coastal context - Fragmented mgmt	0.64 - 1.01	0.39 - 2.54	0.05 - 0.47	1.38 - 4.3	0.03 - 18.37	0.29 - 2.12	0.63 - 1.38	0.63 - 1.84
2010 coastal context - ManyMPA	0.37 - 2.29	0.28 - 1.75	0.03 - 0.39	0.89 - 1.49	0 - 1.7	0.3 - 2.33	0.23 - 0.48	0.32 - 1.43
2010 coastal context - Seasons	1.05 - 7.76	0.93 - 16.98	0.04 - 0.37	3.98 - 8.19	3.74 - 231.18	0.17 - 1.25	0.67 - 1.28	3.71 - 11.4
2010 coastal context - SlowAssess	0.38 - 10.72	0.3 - 0.73	0.04 - 0.47	0.6 - 4.45	0.26 - 8.44	0.31 - 2.76	0.85 - 1.34	0.74 - 4.27
2010 coastal context - Integrated Mgmt	0.3 - 1.37	0.48 - 1.49	0.04 - 0.47	1.19 - 5.82	0.99 - 56.35	0.29 - 2.12	0.61 - 1.35	0.69 - 3.2
Cumulative impacts - 2010 Status Quo	0.13 - 0.41	0.04 - 1.02	0.04 - 0.45	1.09 - 2.91	0 - 0.02	0.27 - 1.97	0.42 - 0.95	0.29 - 0.66
Cumulative impacts - Cap ecosystem take	0.16 - 7.53	0.03 - 0.58	0.05 - 0.45	1.1 - 4.44	0 - 0.39	0.27 - 1.97	0.41 - 0.94	0.36 - 3.25
Cumulative impacts - Centralised mgmt.	0.12 - 4.83	0.03 - 0.81	0.04 - 0.45	1.02 - 3.44	0 - 0.02	0.27 - 1.97	0.44 - 0.92	0.28 - 2.26
Cumulative impacts - FewMPA	0.23 - 2.09	0.19 - 1.32	0.04 - 0.29	1.87 - 6.25	0 - 0.02	0.23 - 1.68	0.27 - 0.45	0.33 - 1.2
Cumulative impacts - Fragmented mgmt	0.15 - 0.48	0.03 - 1.02	0.06 - 0.45	1.38 - 3.07	0 - 0.02	0.27 - 1.97	0.42 - 0.95	0.35 - 0.66
Cumulative impacts - ManyMPA	0.17 - 5.25	0.03 - 0.72	0.03 - 0.37	1.1 - 2.38	0 - 0.01	0.28 - 2.13	0.19 - 0.37	0.22 - 2.3
Cumulative impacts - Seasons	0.2 - 1.51	0.22 - 1.5	0.05 - 0.35	6.03 - 25.93	0.03 - 0.14	0.16 - 1.17	0.34 - 0.72	0.95 - 1.5
Cumulative impacts - SlowAssess	0.27 - 1.75	0.03 - 0.31	0.05 - 0.45	0.71 - 3.42	0 - 0.21	0.28 - 2.58	0.61 - 0.93	0.3 - 1.05
Cumulative impacts - IM	0.16 - 7.53	0.05 - 0.59	0.05 - 0.45	1.1 - 4.44	0 - 0.39	0.27 - 1.97	0.41 - 0.94	0.36 - 3.25
Expanded LTL fishery - IM	0.66 - 3.23	0.41 - 2.96	0.04 - 0.47	0.88 - 3.9	0.77 - 33.87	0.29 - 2.13	0.65 - 1.38	1.01 - 2.55
New mesopelgic fishery - IM	0.48 - 1.66	0.65 - 18.32	11.07 - 16.75	4.48 - 19.47	1.46 - 26.5	0.32 - 2.37	0.79 - 1.48	3.95 - 8.2
Extreme climate events - IM	0.09 - 0.57	0.91 - 7.24	0.08 - 1.04	6.83 - 20.29	0.09 - 2.47	0.32 - 2.36	0.73 - 1.46	0.84 - 2.57
Blooms - IM	0.08 - 0.56	0.92 - 6.59	0.07 - 1.04	7.58 - 23.29	0.15 - 8.54	0.32 - 2.37	0.71 - 1.61	0.9 - 3.04
Primary production regime shift - IM	0.5 - 3.13	0.95 - 5.48	0.08 - 1.04	7.06 - 14.62	0.36 - 27.69	0.32 - 3.28	0.72 - 1.88	0.86 - 3.53
Fish kills - IM	0.08 - 0.55	0.95 - 2.16	0.08 - 1.04	6.81 - 32.52	0.43 - 3.89	0.32 - 2.37	0.72 - 1.55	0.83 - 2.08
Range extensions - IM	0.39 - 18.88	0.3 - 2.92	0.04 - 0.47	0.57 - 5.24	0.75 - 24.5	0.31 - 2.76	0.86 - 1.36	0.69 - 7.49
Gear switching allowed - IM	0.89 - 7.36	0.34 - 1.5	0.03 - 0.3	0.91 - 2.51	13.02 - 182.21	0.27 - 1.99	0.69 - 1.37	2.65 - 8.75
High compliance - IM	0.47 - 1.74	0.26 - 1.45	0.04 - 0.47	1.09 - 5.47	0.07 - 3.38	0.29 - 2.12	0.65 - 1.37	0.86 - 1.1

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
Low Compliance - IM	0.23 - 0.97	0.25 - 3.07	0.04 - 0.47	0.97 - 5.7	0.23 - 7.34	0.29 - 2.12	0.63 - 1.37	0.37 - 1.55
Flexible fisher behaviour - IM	0.62 - 2.37	0.29 - 2.27	0.07 - 1.18	1.13 - 5.45	0.76 - 35.79	0.84 - 6.15	0.78 - 1.6	1.16 - 2.77
Increased fishing pressure drivers - IM	0.3 - 1.37	0.26 - 1.42	0.04 - 0.47	1.19 - 5.82	0.56 - 8.8	0.29 - 2.12	0.61 - 1.35	0.66 - 1.19
High Cost, Low Values - IM	1.39 - 14.39	0.82 - 11.31	0.03 - 0.34	1.29 - 2.59	11.16 - 157.18	0.25 - 1.87	0.49 - 1.05	4.18 - 9.17
Low Costs, High Values - IM	0.8 - 0.98	0.2 - 0.93	0.04 - 0.47	1.21 - 5.41	2.85 - 391.39	0.29 - 2.12	0.62 - 1.32	0.92 - 17.56
Standard Markets - IM	0.44 - 1.22	0.51 - 2.56	0.04 - 0.47	1.23 - 3.91	3.04 - 18.37	0.29 - 2.12	0.63 - 1.38	0.74 - 1.85
Technology Creep - IM	1.26 - 12.76	0.5 - 2.52	0.06 - 0.78	0.6 - 4.72	5.41 - 241.24	0.57 - 4.17	0.86 - 1.62	2.88 - 11.79
No Acclimation - 2010 coastal context - IM	0.78 - 2.37	0.04 - 5.58	0 - 0	5.14 - 16.7	0.02 - 2630.25	0.07 - 0.48	2.17 - 4.39	1.89 - 116.59
No Acclimation - Cumulative impacts - SQ	0.43 - 1.49	0.01 - 0.16	0 - 0	4.51 - 16.04	0.02 - 909.13	0.07 - 0.45	2.22 - 4.3	1.57 - 40.36

Table 15: Range of relative landings (in 2065-2070) by class of organism for Atlantis SE under the RCP 4.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
No Climate change - 2010 context - SQ	0.69 - 2.51	0.92 - 1.54	0.34 - 2.37	1.21 - 2.72	0.18 - 9.19	0.26 - 1.51	1.22 - 2.11	1.39 - 1.84
2010 coastal context - Cap ecosystem take	0.29 - 0.93	0.3 - 1.43	0.05 - 0.58	1.31 - 6.86	0.99 - 8.69	0.28 - 2.08	0.6 - 1.48	0.73 - 1.25
2010 coastal context - Centralised mgmt.	0.5 - 0.94	0.31 - 2.05	0.04 - 0.58	1.17 - 5.41	0 - 20.31	0.28 - 2.08	0.6 - 1.46	0.56 - 1.88
2010 coastal context - FewMPA	1.19 - 9.43	0.86 - 4.16	0.04 - 0.37	1.47 - 2.4	2.29 - 152.48	0.24 - 1.78	0.44 - 0.8	2.33 - 7.79
2010 coastal context - Fragmented mgmt	0.68 - 0.87	0.46 - 2.57	0.06 - 0.58	1.53 - 4.95	0 - 18.14	0.28 - 2.08	0.62 - 1.51	0.6 - 1.91
2010 coastal context - ManyMPA	0.41 - 2.36	0.32 - 1.77	0.04 - 0.48	0.98 - 1.55	0 - 0.17	0.3 - 2.3	0.22 - 0.53	0.32 - 1.42
2010 coastal context - Seasons	1.13 - 6.05	0.77 - 19.26	0.05 - 0.45	4.12 - 8.16	0.04 - 228.35	0.17 - 1.23	0.66 - 1.38	1.88 - 11.36
2010 coastal context - SlowAssess	0.4 - 4.6	0.34 - 0.74	0.05 - 0.58	0.64 - 5.21	0 - 8.34	0.31 - 2.71	0.84 - 1.47	0.79 - 1.97
2010 coastal context - Integrated Mgmt	0.29 - 0.93	0.52 - 1.5	0.05 - 0.58	1.31 - 6.86	0.99 - 8.69	0.28 - 2.08	0.6 - 1.48	0.76 - 1.26
Cumulative impacts - 2010 Status Quo	0.13 - 0.42	0.05 - 1.04	0.06 - 0.55	1.17 - 3.61	0 - 2468.59	0.26 - 1.94	0.41 - 1.05	0.3 - 107.36
Cumulative impacts - Cap ecosystem take	0.16 - 7.47	0.03 - 0.65	0.07 - 0.55	1.18 - 5.62	0 - 0.04	0.26 - 1.94	0.4 - 1.04	0.36 - 3.27
Cumulative impacts - Centralised mgmt.	0.12 - 4.8	0.03 - 0.82	0.06 - 0.55	1.09 - 4.28	0 - 0.02	0.26 - 1.94	0.43 - 1.02	0.28 - 2.3
Cumulative impacts - FewMPA	0.22 - 2.08	0.23 - 1.34	0.05 - 0.35	1.97 - 6.18	0 - 0.02	0.22 - 1.65	0.27 - 0.5	0.35 - 1.23
Cumulative impacts - Fragmented mgmt	0.14 - 0.42	0.04 - 1.04	0.07 - 0.55	1.5 - 3.81	0 - 0.02	0.26 - 1.94	0.41 - 1.05	0.4 - 0.71
Cumulative impacts - ManyMPA	0.17 - 5.25	0.03 - 0.73	0.04 - 0.45	1.35 - 2.36	0 - 0.01	0.28 - 2.1	0.18 - 0.41	0.24 - 2.33

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
Cumulative impacts - Seasons	0.17 - 1.52	0.26 - 1.52	0.06 - 0.43	6.39 - 25.64	0 - 0.04	0.16 - 1.14	0.33 - 0.79	1.1 - 1.48
Cumulative impacts - SlowAssess	0.23 - 1.75	0.03 - 0.41	0.06 - 0.55	0.73 - 4.27	0 - 0.01	0.28 - 2.53	0.6 - 1.03	0.3 - 1.09
Cumulative impacts - IM	0.16 - 7.47	0.05 - 0.65	0.07 - 0.55	1.18 - 5.62	0 - 0.01	0.26 - 1.94	0.4 - 1.04	0.36 - 3.27
Expanded LTL fishery - IM	0.69 - 1.65	0.48 - 3	0.06 - 0.58	0.95 - 4.37	0 - 33.46	0.28 - 2.09	0.64 - 1.51	0.85 - 2.61
New mesopelgic fishery - IM	0.42 - 1.09	1.3 - 18.62	2.52 - 2675.25	5.06 - 24.61	0 - 26.17	0.32 - 2.33	0.78 - 1.62	5.87 - 684.84
Extreme climate events - IM	0.09 - 0.64	1.87 - 7.36	0.1 - 1.3	7.78 - 26.51	0 - 2.44	0.32 - 2.32	0.72 - 1.59	1.02 - 2.74
Blooms - IM	0.08 - 0.63	1.18 - 6.69	0.09 - 1.31	8.64 - 30.66	0 - 8.43	0.32 - 2.33	0.7 - 1.76	1.02 - 3.24
Primary production regime shift - IM	0.51 - 2.73	1.89 - 5.57	0.1 - 1.3	8.04 - 15.87	0 - 27.8	0.32 - 3.27	0.71 - 1.91	1.04 - 3.53
Fish kills - IM	0.07 - 0.62	1.25 - 2.19	0.1 - 1.31	7.75 - 43.14	0 - 3.85	0.32 - 2.33	0.71 - 1.69	1.01 - 2.68
Range extensions - IM	0.37 - 8	0.35 - 2.97	0.05 - 0.58	0.61 - 6.21	0 - 24.2	0.31 - 2.71	0.85 - 1.49	0.76 - 3.39
Gear switching allowed - IM	0.96 - 4.1	0.37 - 1.49	0.04 - 0.37	0.9 - 2.56	0.03 - 179.98	0.27 - 1.96	0.68 - 1.49	1.43 - 8.71
High compliance - IM	0.48 - 1.01	0.35 - 1.46	0.05 - 0.58	1.19 - 6.18	0 - 3.39	0.28 - 2.08	0.64 - 1.51	0.59 - 1.12
Low Compliance - IM	0.23 - 1	0.28 - 3.11	0.05 - 0.59	1.06 - 6.76	0 - 7.25	0.28 - 2.08	0.62 - 1.5	0.34 - 1.62
Flexible fisher behaviour - IM	0.69 - 1.25	0.37 - 2.3	0.09 - 1.47	1.24 - 6.27	0 - 35.36	0.82 - 6.05	0.76 - 1.75	0.75 - 2.88
Increased fishing pressure drivers - IM	0.29 - 0.93	0.29 - 1.44	0.05 - 0.58	1.31 - 6.86	0 - 8.69	0.28 - 2.08	0.6 - 1.48	0.63 - 1.25
High Cost, Low Values - IM	1.52 - 12.49	0.71 - 11.29	0.03 - 0.41	1.32 - 2.73	0.02 - 155.26	0.25 - 1.84	0.49 - 1.14	1.49 - 9.16
Low Costs, High Values - IM	0.8 - 0.83	0.24 - 0.95	0.05 - 0.58	1.35 - 6.09	0 - 14.12	0.28 - 2.08	0.61 - 1.45	0.56 - 1.54
Standard Markets - IM	0.4 - 0.77	0.59 - 2.59	0.05 - 0.58	1.36 - 4.53	0 - 18.14	0.28 - 2.08	0.62 - 1.51	0.56 - 1.91
Technology Creep - IM	1.35 - 5.49	0.47 - 2.54	0.07 - 0.97	0.62 - 5.04	0.01 - 238.28	0.56 - 4.1	0.85 - 1.77	2.31 - 11.77
No Acclimation - 2010 coastal context - IM	0.8 - 1.69	0.04 - 5.03	0 - 0.01	5.16 - 16.66	0.02 - 2598.05	0.06 - 0.48	2.13 - 4.42	1.65 - 115.17
No Acclimation - Cumulative impacts - SQ	0.43 - 1.12	0.01 - 0.16	0 - 0	4.52 - 16	0.02 - 912.85	0.06 - 0.44	2.18 - 4.33	1.45 - 40.52

Table 16: Range of relative landings (in 2065-2070) by class of organism for Atlantis SE under the RCP 8.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
No Climate change - 2010 context - SQ	0.69 - 2.51	0.92 - 1.54	0.34 - 2.37	1.21 - 2.72	0.18 - 9.19	0.13 - 1.51	1.22 - 2.11	1.39 - 1.84
2010 coastal context - Cap ecosystem take	0.53 - 0.97	0.96 - 2.98	1.84 - 1.99	6.04 - 7.78	0.16 - 6639	0.59 - 5.99	0.55 - 0.58	1.3 - 289.44
2010 coastal context - Centralised mgmt.	0.52 - 0.74	0.94 - 1.91	1.84 - 1.91	5.17 - 6.53	0.38 - 0.81	0.59 - 6	0.55 - 0.56	1.25 - 1.46
2010 coastal context - FewMPA	0.55 - 0.97	1.62 - 1.98	1.16 - 1.24	1.13 - 1.33	2.84 - 279.43	0.51 - 5.09	0.31 - 0.39	1.14 - 13.05
2010 coastal context - Fragmented mgmt	0.54 - 0.8	0.66 - 3.15	1.85 - 2.07	5.13 - 8.04	0.34 - 0.78	0.59 - 6	0.56 - 0.57	1.2 - 1.78
2010 coastal context - ManyMPA	1.15 - 1.47	1.01 - 1.68	1.51 - 1.88	0.78 - 2.26	0.31 - 0.52	0.63 - 6.42	0.16 - 0.21	1.15 - 1.38
2010 coastal context - Seasons	0.55 - 1	0.87 - 3.55	1.25 - 1.44	4 - 5.37	4.26 - 4.48	0.35 - 3.53	0.54 - 0.57	1.29 - 1.6
2010 coastal context - SlowAssess	0.38 - 0.8	0.92 - 2.03	1.7 - 1.93	2.08 - 6.24	0.66 - 3.05	0.59 - 11.42	0.55 - 0.76	1.25 - 1.46
2010 coastal context - Integrated Mgmt	0.53 - 0.97	0.98 - 2.98	1.84 - 1.99	6.04 - 7.78	0.25 - 66.39	0.59 - 5.99	0.55 - 0.58	1.36 - 4.59
Cumulative impacts - 2010 Status Quo	0.18 - 0.44	0.49 - 2.67	1.66 - 2.14	3.91 - 5.65	0 - 0.01	0.55 - 5.57	0.38 - 0.41	0.88 - 1.38
Cumulative impacts - Cap ecosystem take	0.28 - 21.59	0.5 - 3.6	1.68 - 2.22	3.82 - 7.2	0 - 462.42	0.55 - 5.57	0.38 - 0.42	1.08 - 21.55
Cumulative impacts - Centralised mgmt.	0.19 - 13.38	0.49 - 2.19	1.64 - 2.12	3.26 - 5.19	0 - 567.53	0.55 - 5.58	0.37 - 0.44	0.93 - 25.83
Cumulative impacts - FewMPA	0.16 - 5.02	0.58 - 2.09	1.1 - 1.31	2.28 - 3.13	0 - 0.19	0.47 - 4.74	0.18 - 0.26	0.67 - 2.5
Cumulative impacts - Fragmented mgmt	0.21 - 0.36	0.43 - 3.94	1.63 - 2.31	4.6 - 5.65	0 - 0.03	0.55 - 5.57	0.38 - 0.42	0.9 - 1.66
Cumulative impacts - ManyMPA	0.39 - 11.88	0.52 - 1.08	1.33 - 2.08	1.31 - 2.02	0 - 0.36	0.58 - 5.94	0.13 - 0.18	0.72 - 5.14
Cumulative impacts - Seasons	0.29 - 3.26	0.37 - 1.02	1.2 - 1.41	7.96 - 14.02	0 - 30.66	0.33 - 3.3	0.29 - 0.33	1.31 - 2.66
Cumulative impacts - SlowAssess	0.28 - 4.41	0.49 - 2.4	1.67 - 1.89	0.94 - 5.24	0 - 0.01	0.55 - 10.65	0.37 - 0.58	1.06 - 2.52
Cumulative impacts - IM	0.28 - 21.59	0.5 - 3.6	1.68 - 2.22	3.82 - 7.2	0 - 0.46	0.55 - 5.57	0.38 - 0.42	1.08 - 8.98
Expanded LTL fishery - IM	0.54 - 0.74	1.17 - 2.94	1.83 - 1.93	3.6 - 6.4	0.62 - 0.92	0.59 - 6	0.56 - 0.59	1.19 - 1.55
New mesopelgic fishery - IM	0.23 - 0.9	0.61 - 9.39	5.48 - 30.38	26.31 - 62.58	0.49 - 1.78	0.66 - 6.72	0.62 - 0.7	5.45 - 10.8
Extreme climate events - IM	0.26 - 0.66	0.6 - 13.78	3.78 - 4.15	37.16 - 50.01	0.02 - 0.62	0.66 - 6.69	0.61 - 0.68	3.2 - 5.45
Blooms - IM	0.23 - 0.68	0.34 - 10.07	3.73 - 4.17	43.86 - 69.21	0.04 - 0.16	0.66 - 6.7	0.62 - 0.67	3.48 - 5.16
Primary production regime shift - IM	0.55 - 0.7	0.96 - 13.68	3.73 - 4.15	8.09 - 46.76	0.19 - 7.07	0.66 - 12.64	0.63 - 1.02	2.36 - 5.5
Fish kills - IM	0.24 - 0.59	0.41 - 13.56	3.77 - 4.16	42.32 - 63.01	0.07 - 0.51	0.66 - 6.7	0.63 - 0.69	4.25 - 5.4
Range extensions - IM	0.62 - 1.44	0.92 - 5.32	1.69 - 1.95	2.72 - 7.55	0.38 - 8.84	0.59 - 11.44	0.56 - 0.76	1.38 - 2.43
Gear switching allowed - IM	0.59 - 0.9	1.27 - 2.27	1.13 - 1.18	1.2 - 1.47	3.33 - 3.37	0.56 - 5.62	0.56 - 0.6	1.04 - 1.21
High compliance - IM	0.44 - 0.87	0.93 - 2.16	1.83 - 1.96	5.44 - 6.16	0.05 - 0.86	0.59 - 6	0.56 - 0.59	1.18 - 1.49
Low Compliance - IM	0.44 - 0.6	0.79 - 2.13	1.87 - 2.1	3.83 - 7.41	0.03 - 0.19	0.59 - 5.99	0.56 - 0.59	1.29 - 1.33

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Squid	Filter feeders	Macrozoobenthos	Total
Flexible fisher behaviour - IM	0.75 - 0.95	1.89 - 2.76	4.66 - 4.87	5.12 - 6.64	0.66 - 0.89	1.72 - 17.39	0.67 - 0.69	2.35 - 2.49
Increased fishing pressure drivers - IM	0.53 - 0.97	0.96 - 2.98	1.84 - 1.99	6.04 - 7.78	0.16 - 0.66	0.59 - 5.99	0.55 - 0.58	1.3 - 1.75
High Cost, Low Values - IM	0.54 - 1.11	1.49 - 2.66	1.13 - 1.3	1.23 - 1.3	2.82 - 2.9	0.52 - 5.26	0.41 - 0.44	0.99 - 1.39
Low Costs, High Values - IM	0.77 - 1.65	0.93 - 2.8	1.84 - 2.02	6.17 - 6.34	0.26 - 461.12	0.59 - 6	0.54 - 0.56	1.4 - 21.62
Standard Markets - IM	0.34 - 1.1	0.96 - 2.37	1.85 - 1.93	4.2 - 8.04	0.34 - 0.79	0.59 - 6	0.56 - 0.57	1.12 - 1.72
Technology Creep - IM	0.72 - 1	1.84 - 2.68	2.73 - 3.22	1.68 - 2.91	4.45 - 6.37	1.16 - 11.75	0.69 - 0.76	1.87 - 2.05
No Acclimation - 2010 coastal context - IM	0.84 - 2.66	0.19 - 1.38	0.02 - 0.02	1.84 - 2.43	48.5 - 198.4	0.13 - 1.36	2.09 - 2.2	2.84 - 10.2
No Acclimation - Cumulative impacts - SQ	0.51 - 2.91	0.13 - 0.45	0.02 - 0.02	1.68 - 2.48	0.02 - 237.21	0.12 - 1.36	1.51 - 2.15	0.51 - 11.85

mesopelagics; or increased fishing pressure – either directly, through technology creep, a reduction in spatial management or low compliance. Improved stock status under high compliance or extensive seasonal closures also allowed for increased total landings. The time trajectory for total landings tends to grow slowly through time (e.g. for integrated management in Figure 30) either on the back of a few species becoming more productive or because new functional groups were added to the list of regularly landed species. Contractions in total landings occurred when stocks could no longer support historical levels of landings, regulation prevented access (even if TACs themselves did not drop, as was the case under some of the simulations with extensive spatial closures, for example) or when it was no longer profitable to pursue a modelled group. The first of these causes (a change in stock status as a result of environmental or cumulative stressors) is the most common mechanism behind a decrease in catch across the simulations; a lack of access is an issue when there are extensive closures and can arise in some states with centralised management. Profitability constrained the fishing behaviour of some fleets under a range of combinations of parameterisation and management strategy, but was often an issue when there were high costs (or low value of product), or gear switching.

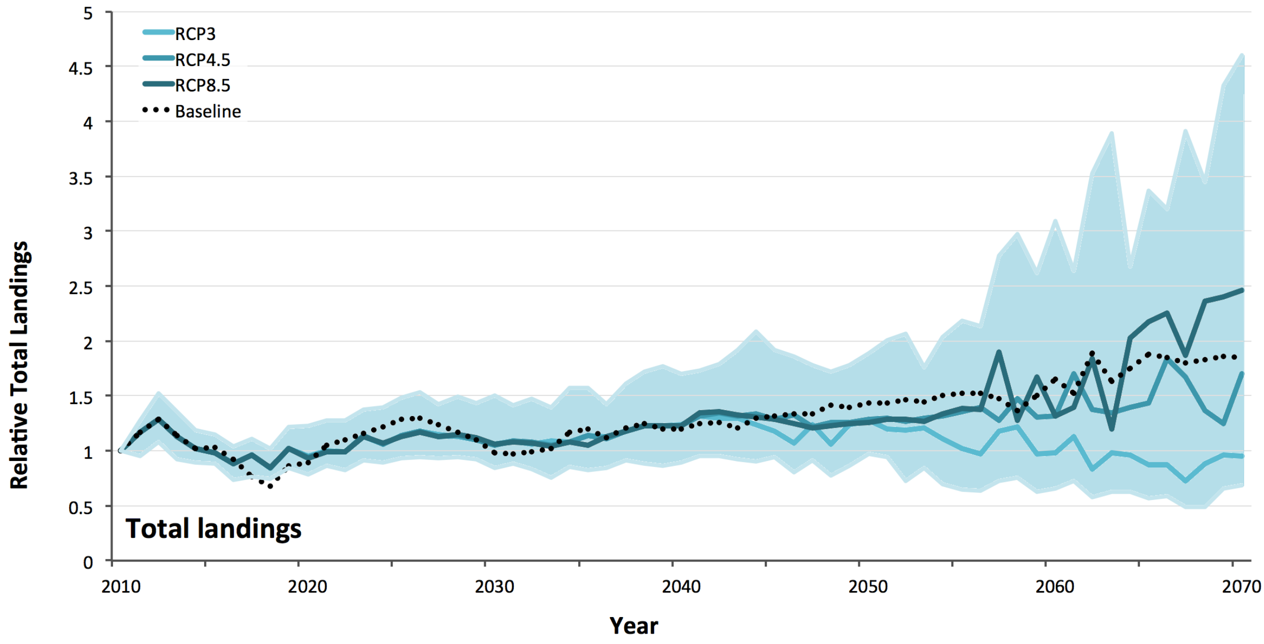


Figure 30: Average relative total landings through time from Atlantis-SE under each emission scenarios. The lighter shaded area is the total range.

The shifts in community structure are reflected to some degree in the changed landings composition (Figures 31-33). With acclimation, the contribution by invertebrates (particularly squid) does not change as strongly as when there is no acclimation. Under RCP 3 and 4.5 the composition continues to reflect a strong preference for demersal species (benthic invertebrates and finfish), high value pelagic predators and sharks, with only a minor contribution by forage fish (despite the later becoming a major part of system biomass). While this is not completely implausible, past shifts in national palates (witness the transition of Peruvian anchoveta from a fish considered only suitable for reduction to fishmeal to one that is considered a flavoursome fish for human consumption) mean it is possible that stronger shifts in catch composition are possible with suitable education of the Australian palate. This is what is seen under RCP 8.5 where forage fish come to make up a significant proportion of the landings.

Even without strong changes in palate and associated market demand, the gross binning of the functional groups in to broad taxa types in Tables 15-17 hides a turnover in target species through time. Similarly the shift in species composition represented by the shift in parameters within aggregate functional groups under evolution indicates that for the modelled levels of fishing to occur the fishers must change their targeting to some extent. This is particularly true under RCP 8.5, where they push to a broader set of species than currently targeted. This means that even when the overall distribution across taxa of the catch is broadly the same as now the identity of specific targeted species and total diversity is actually

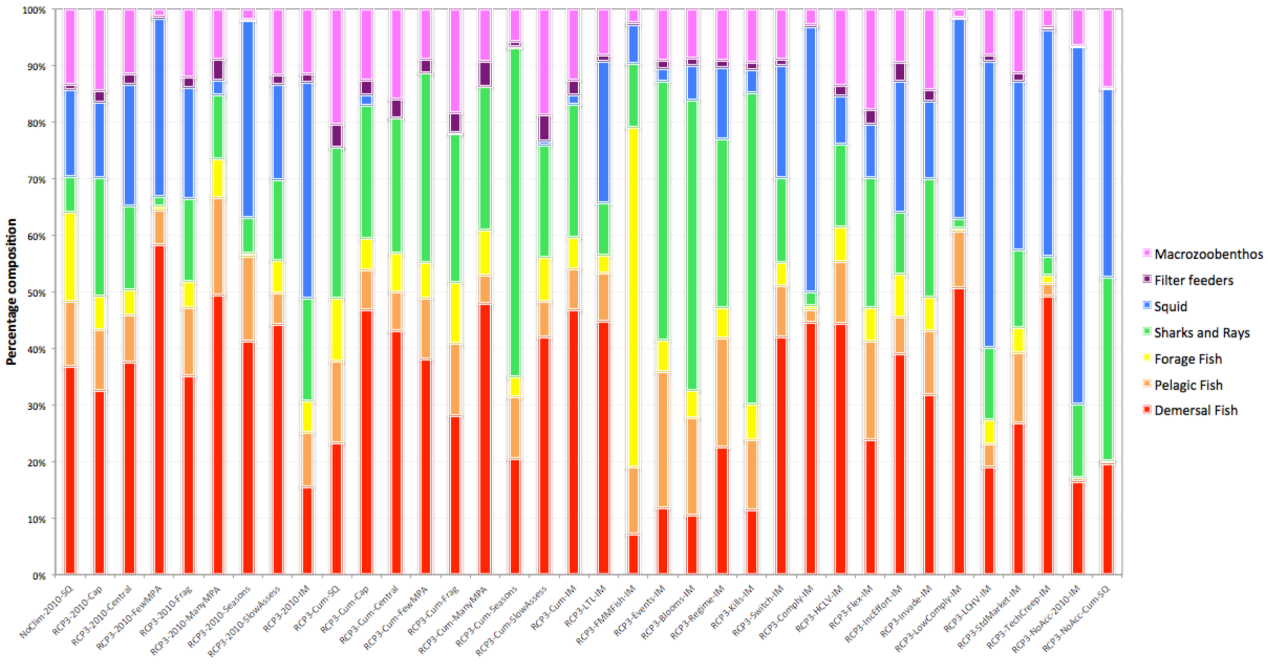


Figure 31: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SE under RCP 3

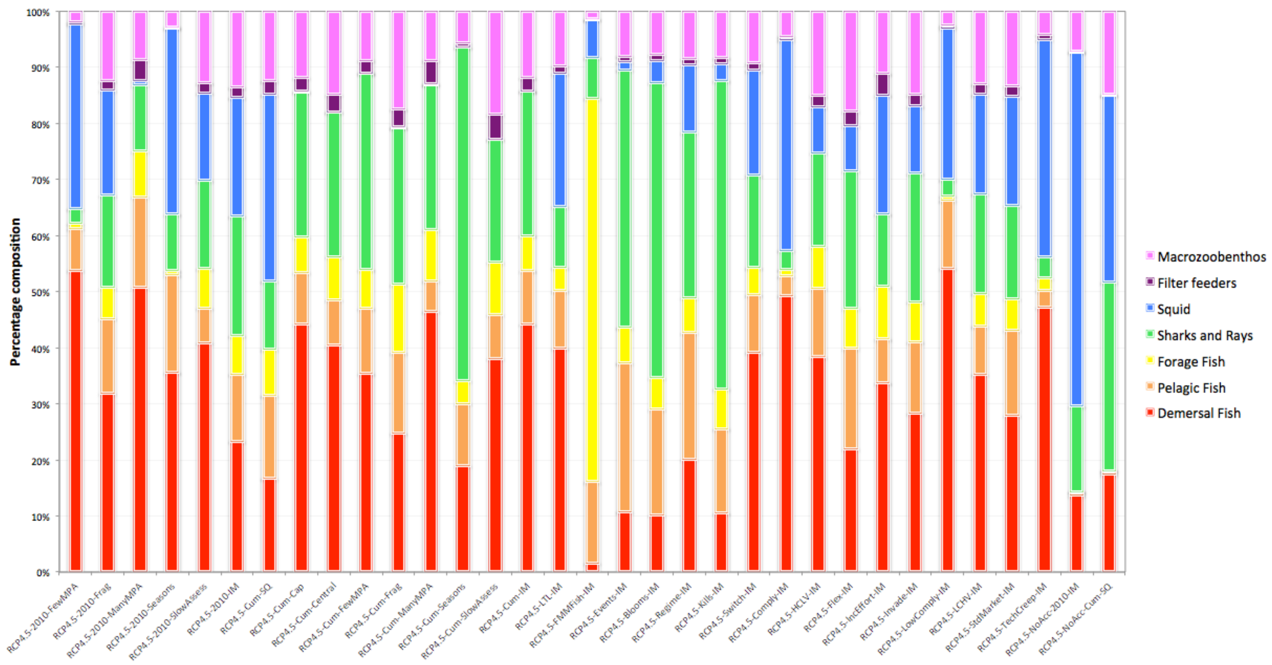


Figure 32: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SE under RCP 4.5

substantially different and fishers would note strong specific changes to today. Even under RCP 3 and 4.5 some of the parameterisations see current target species (e.g. flathead), or desirable substitutes (e.g. amongst the shallow demersal fish), amongst those showing negative biomass outcomes and so their landings can also drop forcing fishers to switch to other targets.

It is interesting to note that under RCP 3 and 4.5 the landings composition differs between the cumulative impacts scenarios and the other development cases. There is a pattern of a greater contribution by sharks

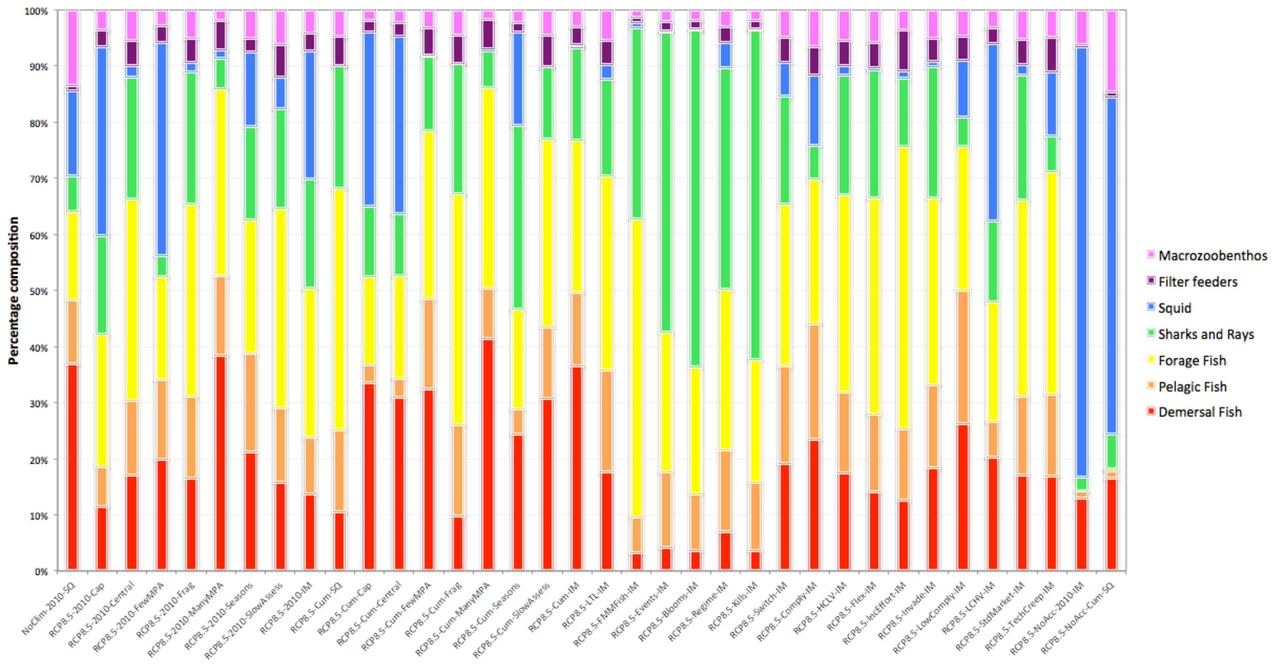


Figure 33: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SE under RCP 8.5

and less by squid (and demersal fish) under cumulative impacts. This distinction no longer exists under RCP 8.5. When there are extreme events, regime shifts or fish kills under any emissions scenario then shark contribution to landings is higher and the contribution by demersal fish is half (or even lower).

Within simulations volatility in landings and composition is much higher in the lower productivity case and under RCP 8.5 across all parameterisations (e.g. Figure 34). Under the lower emissions scenarios is in part due to fisher behaviour, for example the catches of demersal groups is more volatile when there is flexible fisher behaviour, gear switching, non-compliance or when there are large scale spatial closures. Year-to-year volatility in landings of pelagic groups (e.g. forage fish) was greatest in simulations containing periodic large bloom events (though not when there is a regime shift in productivity. Under RCP 8.5 the fisheries data can also be an effective spatial filter that detects oncoming system-wide state changes. The coefficient of variation (CV) on total landings (Table 17) increased substantially as the biological system underwent the greatest structural and productivity changes. This increase in CV occurred before any signal is detectable in overall stock status, though explicitly spatial monitoring schemes would detect shifts. This result is because the spatial extent of the fisheries is much more spatially constrained than the stock movements, both due to economic and regulatory constraints. Consequently, the signal in the landings highlights the system changes more rapidly than aggregate stock status.

Table 17: Mean within simulation (i.e. year-to-year) coefficient of variation of relative total landings (2060-2070) in Atlantis-SE under different emissions scenarios.

Emissions scenario	CV of Landings
No climate change	0.062
RCP 3	0.070
RCP 4.5	0.072
RCP 8.5	0.143
No acclimation	0.079

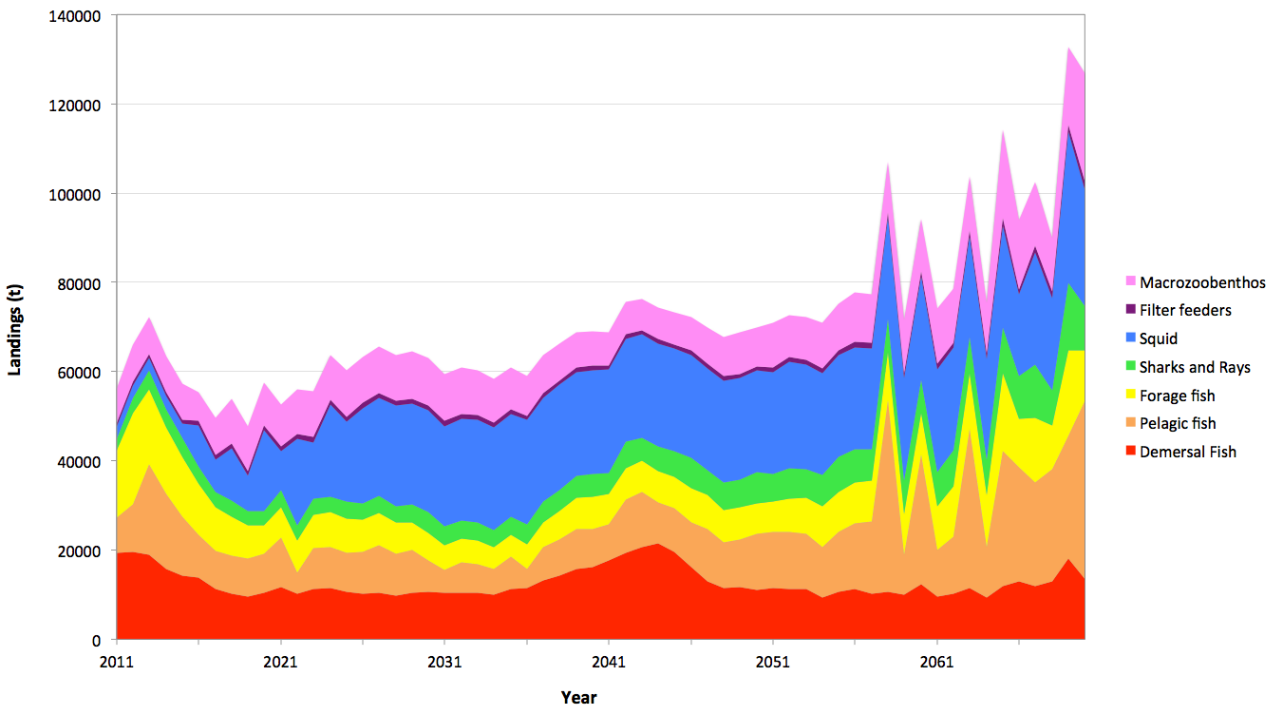


Figure 34: Example of catch composition through time under RCP 8.5 in Atlantis-SE (for the integrated management strategy with a medium productivity parameterisation).

EFFORT

Just as there is considerable variation across the responses by individual functional groups under combinations of scenarios, parameterisations and management strategies, there is considerable variation across fleets and gears (Tables 18-20). Invertebrate fisheries increased their effort in most instances, except when there are extensive closures. The increases in effort are driven by invertebrate trawl fisheries (e.g. for prawns); the dive, dredge and lobster potting decrease except for the scenario where there is an increase in effort or low compliance.

Trap and line fisheries for finfish or sharks tend to increase under RCP 3 and 4.5 except when there are cumulative impacts (then the results are more variable). These fleets scale back under RCP 8.5, with scenarios that see an increase under the lower emissions becoming mixed and those that were mixed converting to a decline in effort.

More broadly most gear types (fleets) decrease effort under RCP 8.5 into the long term, even when there is an interim increase in fishing pressure. Under RCP 3 and 4.5 net fishing decreases in all cases, except when there is little spatial management. Purse seine also often contracts (or at best holds steady), except when there is an explicit intensification of demand and fishing pressure or low compliance – or at the other extreme when compliance is very high under integrated management (where there is a substantial recovery of many fish stocks which sustainably support small increases in purse seine effort). Across the other gear types (and effort overall) there are decreases for many of the management strategies and scenarios under RCP 3 and 4.5 – except where there was the potential via behaviour (in terms of flexibility or compliance), increased market demand, improved technological efficiencies, lower cost structures or new fisheries which allow for expansions of effort. Some small effort increases were also possible at a system level under more productive parameterisations and extensive closures if there was sufficient flow from closed areas (times) to points (or periods) where the fishery could access.

Gear switching was only really taken up if the system productivity was low, or there were significant bloom effects. When reduction in effort came about via a retirement of licences and vessels rather than just a reduction in days fished effectively saw consolidation of the remaining licences in a small number of gear types (primarily trawl gear). The greatest contraction in fleet size is typically by the finfish mesh net under all emissions scenarios, although the contraction of the trawl fleets can come close to matching the contraction of the net fisheries under RCP 8.5 and the greatest contraction of all is by longline when there are cumulative impacts and wide spread spatial closures.

Table 18: Range of relative effort in 2065-2070 per gear class in Atlantis-SE under RCP 3.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.55 - 0.79	0.58 - 0.72	1.22 - 1.3	1.29 - 1.37	1.42 - 1.78
2010 coastal context - Cap ecosystem take	0.46 - 0.82	0.58 - 0.77	1.2 - 1.34	1.29 - 1.49	1.35 - 1.56
2010 coastal context - Centralised mgmt.	0.48 - 0.93	0.55 - 0.77	1.11 - 1.33	1.2 - 1.37	1.36 - 1.7
2010 coastal context - FewMPA	0.12 - 0.76	0.12 - 1.05	0.09 - 0.78	1.19 - 3.87	0.2 - 1.34
2010 coastal context - Fragmented mgmt	0.53 - 1.01	0.52 - 0.69	1.06 - 1.24	1.17 - 1.48	1.31 - 1.59
2010 coastal context - ManyMPA	0.08 - 0.52	0.21 - 1.23	0.2 - 1.25	0.81 - 3.73	0.33 - 1.95
2010 coastal context - Seasons	0.2 - 0.45	0.13 - 1.15	0.12 - 1.07	1.25 - 3.73	0.22 - 1.65
2010 coastal context - SlowAssess	0.52 - 0.8	0.71 - 0.88	1.14 - 1.25	1.25 - 1.32	1.38 - 1.6
2010 coastal context - Integrated Mgmt	0.46 - 0.82	0.58 - 0.77	1.2 - 1.34	1.29 - 1.49	1.35 - 1.56
Cumulative impacts - 2010 Status Quo	0.41 - 0.63	0.32 - 0.66	0.79 - 1.45	1.35 - 2.48	0.94 - 1.59
Cumulative impacts - Cap ecosystem take	0.38 - 0.86	0.5 - 0.67	1.15 - 1.39	1.21 - 1.7	1.38 - 1.5
Cumulative impacts - Centralised mgmt.	0.39 - 0.97	0.45 - 0.7	1.04 - 1.45	1.32 - 1.59	1.25 - 1.6
Cumulative impacts - FewMPA	0.08 - 0.6	0.05 - 1.08	0.04 - 0.93	1.22 - 4.1	0.08 - 1.51
Cumulative impacts - Fragmented mgmt	0.37 - 1.04	0.43 - 0.63	1 - 1.35	1.24 - 1.75	1.2 - 1.52
Cumulative impacts - ManyMPA	0.04 - 0.61	0.09 - 1.11	0.1 - 1.3	0.79 - 4.05	0.15 - 1.91
Cumulative impacts - Seasons	0.13 - 0.37	0.05 - 1.14	0.05 - 1.23	1.2 - 4.01	0.1 - 1.81
Cumulative impacts - SlowAssess	0.37 - 0.86	0.57 - 0.81	1.06 - 1.39	1.29 - 1.6	1.25 - 1.52
Cumulative impacts - IM	0.38 - 0.86	0.5 - 0.67	1.15 - 1.39	1.21 - 1.7	1.38 - 1.5
Expanded LTL fishery - IM	0.51 - 1.17	0.38 - 0.71	0.8 - 1.27	1.25 - 1.45	1.14 - 1.63
New mesopelgic fishery - IM	0.51 - 1.17	0.38 - 0.71	0.8 - 1.26	1.25 - 1.45	1.14 - 1.62
Extreme climate events - IM	0.47 - 0.89	0.57 - 0.76	1.14 - 1.36	1.21 - 1.46	1.36 - 1.57
Blooms - IM	0.46 - 0.86	0.55 - 0.79	1.13 - 1.37	1.17 - 1.44	1.34 - 1.59
Primary production regime shift - IM	0.39 - 0.85	0.26 - 0.59	0.39 - 1.19	1.23 - 3.07	0.5 - 1.43
Fish kills - IM	0.44 - 0.81	0.6 - 0.78	1.2 - 1.35	1.27 - 1.43	1.36 - 1.68
Range extensions - IM	0.45 - 0.77	0.57 - 0.68	1.15 - 1.19	1.27 - 1.69	1.34 - 1.57
Gear switching allowed - IM	0.64 - 2.58	0.02 - 0.81	0.04 - 1.24	0.49 - 2.08	0.07 - 1.49
High compliance - IM	0.4 - 0.69	0.45 - 0.64	0.78 - 1.3	1.33 - 2.43	0.99 - 1.61
Low Compliance - IM	0.45 - 0.73	0.35 - 0.72	0.77 - 1.4	1.3 - 2.06	0.94 - 1.62
Flexible fisher behaviour - IM	0.28 - 0.5	0.35 - 0.38	1.6 - 1.77	1.55 - 1.96	1.57 - 1.71
Increased fishing pressure drivers - IM	0.46 - 0.82	0.58 - 0.77	1.2 - 1.34	1.29 - 1.49	1.35 - 1.56
High Cost, Low Values - IM	0.66 - 2.32	0.03 - 0.88	0.04 - 1.13	0.87 - 2.65	0.06 - 1.45
Low Costs, High Values - IM	0.28 - 0.79	0.19 - 0.6	0.33 - 1.22	1.3 - 3.35	0.43 - 1.39
Standard Markets - IM	0.53 - 0.71	0.45 - 0.7	0.94 - 1.28	1.34 - 2.07	1.15 - 1.61
Technology Creep - IM	0.63 - 1.92	0.04 - 0.5	0.13 - 1.4	1.3 - 2.69	0.19 - 1.6
No Acclimation - 2010 coastal context - IM	0.77 - 2.42	0 - 0.01	0.04 - 0.13	0.74 - 3.03	0.05 - 0.17
No Acclimation - Cumulative impacts - SQ	1.02 - 2.43	0 - 0.01	0.04 - 0.13	0.72 - 2.64	0.06 - 0.21

Table 19: Range of relative effort in 2065-2070 per gear class in Atlantis-SE under RCP 4.5.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.55 - 0.79	0.58 - 0.72	1.22 - 1.3	1.29 - 1.37	1.42 - 1.62
2010 coastal context - Cap ecosystem take	0.43 - 0.78	0.6 - 0.78	1.2 - 1.36	1.29 - 1.5	1.36 - 1.58
2010 coastal context - Centralised mgmt.	0.46 - 0.93	0.55 - 0.78	1.11 - 1.34	1.21 - 1.4	1.36 - 1.72
2010 coastal context - FewMPA	0.12 - 0.71	0.12 - 1.07	0.09 - 0.77	1.27 - 3.9	0.19 - 1.32
2010 coastal context - Fragmented mgmt	0.49 - 1	0.53 - 0.7	1.06 - 1.25	1.17 - 1.5	1.31 - 1.61
2010 coastal context - ManyMPA	0.08 - 0.5	0.21 - 1.23	0.2 - 1.22	0.87 - 3.74	0.34 - 1.9
2010 coastal context - Seasons	0.19 - 0.38	0.12 - 1.17	0.12 - 1.07	1.33 - 3.76	0.21 - 1.64
2010 coastal context - SlowAssess	0.49 - 0.79	0.71 - 0.89	1.14 - 1.27	1.26 - 1.34	1.38 - 1.62
2010 coastal context - Integrated Mgmt	0.43 - 0.78	0.6 - 0.78	1.2 - 1.36	1.29 - 1.5	1.36 - 1.58
Cumulative impacts - 2010 Status Quo	0.38 - 0.62	0.32 - 0.66	0.79 - 1.43	1.38 - 2.49	0.94 - 1.61
Cumulative impacts - Cap ecosystem take	0.36 - 0.85	0.5 - 0.68	1.15 - 1.4	1.25 - 1.71	1.37 - 1.51
Cumulative impacts - Centralised mgmt.	0.36 - 0.96	0.45 - 0.7	1.04 - 1.44	1.33 - 1.61	1.25 - 1.61
Cumulative impacts - FewMPA	0.07 - 0.57	0.04 - 1.08	0.04 - 0.91	1.3 - 4.11	0.08 - 1.47
Cumulative impacts - Fragmented mgmt	0.35 - 1.03	0.43 - 0.64	1 - 1.36	1.3 - 1.77	1.2 - 1.54
Cumulative impacts - ManyMPA	0.04 - 0.58	0.09 - 1.11	0.1 - 1.28	0.86 - 4.06	0.15 - 1.86
Cumulative impacts - Seasons	0.12 - 0.35	0.05 - 1.14	0.05 - 1.2	1.27 - 4.03	0.09 - 1.76
Cumulative impacts - SlowAssess	0.35 - 0.85	0.57 - 0.82	1.06 - 1.38	1.33 - 1.61	1.26 - 1.54
Cumulative impacts - IM	0.36 - 0.85	0.5 - 0.68	1.15 - 1.4	1.25 - 1.71	1.37 - 1.51
Expanded LTL fishery - IM	0.48 - 1.17	0.39 - 0.72	0.8 - 1.28	1.26 - 1.47	1.14 - 1.65
New mesopelgic fishery - IM	0.53 - 1.18	0.39 - 0.7	0.8 - 1.25	1.09 - 1.44	1.12 - 1.61
Extreme climate events - IM	0.43 - 0.88	0.58 - 0.77	1.14 - 1.38	1.21 - 1.48	1.36 - 1.6
Blooms - IM	0.43 - 0.86	0.56 - 0.8	1.13 - 1.39	1.17 - 1.46	1.34 - 1.61
Primary production regime shift - IM	0.32 - 0.84	0.26 - 0.6	0.4 - 1.2	1.24 - 3.14	0.51 - 1.43
Fish kills - IM	0.41 - 0.77	0.61 - 0.79	1.21 - 1.37	1.28 - 1.44	1.36 - 1.7
Range extensions - IM	0.42 - 0.76	0.58 - 0.69	1.15 - 1.2	1.28 - 1.72	1.34 - 1.57
Gear switching allowed - IM	0.62 - 2.54	0.02 - 0.82	0.04 - 1.24	0.54 - 2.33	0.07 - 1.48
High compliance - IM	0.37 - 0.64	0.46 - 0.65	0.78 - 1.31	1.34 - 2.46	1 - 1.61
Low Compliance - IM	0.42 - 0.73	0.35 - 0.73	0.77 - 1.41	1.33 - 2.06	0.94 - 1.64
Flexible fisher behaviour - IM	0.26 - 0.49	0.35 - 0.38	1.62 - 1.77	1.56 - 1.98	1.58 - 1.71
Increased fishing pressure drivers - IM	0.43 - 0.78	0.6 - 0.78	1.2 - 1.36	1.29 - 1.5	1.36 - 1.58
High Cost, Low Values - IM	0.62 - 2.27	0.03 - 0.89	0.04 - 1.12	0.94 - 2.9	0.06 - 1.43
Low Costs, High Values - IM	0.24 - 0.73	0.19 - 0.61	0.34 - 1.24	1.36 - 3.4	0.43 - 1.4
Standard Markets - IM	0.53 - 0.67	0.45 - 0.71	0.94 - 1.28	1.36 - 2.07	1.15 - 1.64
Technology Creep - IM	0.53 - 1.85	0.05 - 0.51	0.13 - 1.4	1.4 - 2.85	0.2 - 1.6
No Acclimation - 2010 coastal context - IM	0.61 - 2.41	0 - 0.01	0.04 - 0.14	0.76 - 3.25	0.05 - 0.18
No Acclimation - Cumulative impacts - SQ	0.86 - 2.42	0 - 0.01	0.04 - 0.14	0.73 - 2.86	0.06 - 0.23

Table 20: Range of relative effort in 2065-2070 per gear class in Atlantis-SE under RCP 8.5.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.55 - 0.79	0.58 - 0.72	1.22 - 1.3	1.29 - 1.37	1.42 - 1.62
2010 coastal context - Cap ecosystem take	0.43 - 0.81	0.49 - 0.65	1.19 - 1.5	1.33 - 1.46	1.46 - 1.73
2010 coastal context - Centralised mgmt.	0.38 - 0.69	0.51 - 0.67	1.25 - 1.56	1.37 - 1.43	1.55 - 1.85
2010 coastal context - FewMPA	0.39 - 0.8	0.86 - 1.01	0.78 - 0.91	1.21 - 1.45	1.45 - 1.73
2010 coastal context - Fragmented mgmt	0.44 - 0.77	0.51 - 0.66	1.22 - 1.53	1.35 - 1.4	1.47 - 1.85
2010 coastal context - ManyMPA	0.47 - 0.54	1.02 - 1.02	1.25 - 1.26	0.85 - 0.92	2.12 - 2.15
2010 coastal context - Seasons	0.38 - 0.74	0.83 - 0.99	0.97 - 1.12	1.14 - 1.34	1.62 - 1.85
2010 coastal context - SlowAssess	0.43 - 0.7	0.63 - 0.8	1.24 - 1.49	1.29 - 1.35	1.55 - 1.78
2010 coastal context - Integrated Mgmt	0.43 - 0.81	0.49 - 0.65	1.19 - 1.5	1.33 - 1.46	1.46 - 1.73
Cumulative impacts - 2010 Status Quo	0.44 - 0.69	0.47 - 0.55	1.43 - 1.58	1.33 - 1.46	1.61 - 1.77
Cumulative impacts - Cap ecosystem take	0.41 - 0.96	0.42 - 0.57	1.26 - 1.57	1.17 - 1.53	1.41 - 1.78
Cumulative impacts - Centralised mgmt.	0.39 - 0.68	0.47 - 0.58	1.44 - 1.63	1.33 - 1.44	1.62 - 1.84
Cumulative impacts - FewMPA	0.37 - 0.67	0.83 - 0.88	0.87 - 0.94	1.23 - 1.72	1.58 - 1.61
Cumulative impacts - Fragmented mgmt	0.42 - 0.97	0.42 - 0.57	1.23 - 1.62	1.19 - 1.42	1.37 - 1.83
Cumulative impacts - ManyMPA	0.46 - 0.65	0.89 - 0.91	1.29 - 1.32	0.79 - 1.12	2.02 - 2.15
Cumulative impacts - Seasons	0.37 - 0.41	0.82 - 0.94	1.08 - 1.27	1.24 - 1.57	1.74 - 1.94
Cumulative impacts - SlowAssess	0.4 - 0.69	0.58 - 0.7	1.38 - 1.56	1.28 - 1.46	1.56 - 1.74
Cumulative impacts - IM	0.41 - 0.96	0.42 - 0.57	1.26 - 1.57	1.17 - 1.53	1.41 - 1.78
Expanded LTL fishery - IM	0.4 - 0.8	0.49 - 0.65	1.19 - 1.52	1.33 - 1.41	1.48 - 1.9
New mesopelgic fishery - IM	0.4 - 0.81	0.49 - 0.65	1.18 - 1.52	1.32 - 1.41	1.47 - 1.89
Extreme climate events - IM	0.42 - 0.8	0.5 - 0.67	1.19 - 1.52	1.33 - 1.45	1.47 - 1.74
Blooms - IM	0.41 - 0.81	0.53 - 0.66	1.2 - 1.53	1.29 - 1.42	1.45 - 1.85
Primary production regime shift - IM	0.39 - 0.81	0.5 - 0.73	1.19 - 1.55	1.33 - 1.42	1.46 - 1.81
Fish kills - IM	0.4 - 0.8	0.5 - 0.69	1.19 - 1.54	1.33 - 1.42	1.46 - 1.81
Range extensions - IM	0.37 - 0.71	0.47 - 0.67	1.14 - 1.54	1.4 - 1.49	1.49 - 1.86
Gear switching allowed - IM	0.53 - 0.64	0.55 - 0.68	1.25 - 1.36	1.28 - 1.32	1.64 - 1.79
High compliance - IM	0.34 - 0.68	0.54 - 0.7	1.3 - 1.59	1.35 - 1.44	1.58 - 1.86
Low Compliance - IM	0.44 - 0.7	0.56 - 0.6	1.38 - 1.53	1.29 - 1.43	1.58 - 1.78
Flexible fisher behaviour - IM	0.2 - 0.39	0.3 - 0.35	1.76 - 1.98	1.71 - 1.74	1.7 - 1.9
Increased fishing pressure drivers - IM	0.43 - 0.81	0.49 - 0.65	1.19 - 1.5	1.33 - 1.46	1.46 - 1.73
High Cost, Low Values - IM	0.65 - 0.77	0.74 - 0.74	1.07 - 1.14	1.2 - 1.29	1.51 - 1.6
Low Costs, High Values - IM	0.46 - 0.76	0.5 - 0.65	1.22 - 1.52	1.35 - 1.42	1.52 - 1.77
Standard Markets - IM	0.46 - 0.69	0.52 - 0.63	1.26 - 1.5	1.38 - 1.43	1.57 - 1.78
Technology Creep - IM	0.34 - 0.62	0.43 - 0.48	1.39 - 1.59	1.39 - 1.54	1.74 - 2
No Acclimation - 2010 coastal context - IM	0.89 - 2.24	0 - 0.09	0.04 - 1.26	1.01 - 1.46	0.05 - 1.54
No Acclimation - Cumulative impacts - SQ	1.21 - 2.22	0 - 0.07	0.04 - 1.09	1.03 - 1.27	0.06 - 1.33

PROFIT AND ECONOMIC INDICATORS

The general trends in absolute catch hide quite strong differential outcomes in terms of gross value of product per unit effort (GVPUE; Tables 21-23). Under RCP 3 and 4.5 the mean GVPUE for forage fish consistently declines, except when a mesopelagic fishery is initiated. This drop in profitability is what drives the contraction in the forage fisheries. The results are more mixed for other product types. The GVPUE for other fish types increases strongly under RCP 8.5 but is more mixed in the other cases – with just as many cases holding steady, or expressing slight decreases, as increasing. The only cases that consistently decline by more than 40% are when there is no acclimation, fragmented management or little spatial management. The GVPUE for sharks increases in most instances, except when there is little spatial management, technology creep, increased fishing pressure, a decrease in compliance or no acclimation. This reflects the poorer stock status in those cases.

The return on investment was highest when fishing intensity was higher, for all emissions scenarios, and was a lot lower with large-scale seasonal or spatial closures. There was no significant difference between the other simulations and the no-climate change case.

Value of lease quota is more complicated than investment. It often increases when management actions are delayed (e.g. assessments occur less often) or when extreme events, blooms or fish kills occur (increasing on average by more than 25%). In contrast, the value of lease quota drops (by 15-25%) with seasonal closures or technology creep under all emissions scenarios and also when there are cumulative pressures and lower productivity parameterisations.

VESSEL SIZES AND EMPLOYMENT

When there is low system productivity, stronger environmental changes or cumulative impacts (i.e. when stock status is environmentally impacted and shifted spatially) there is a general increase in boat size with many of the smaller boats all lost from the system. The greatest increase in boat size was under status quo conditions under RCP 8.5, where all but the largest sizes were lost. For the other productivity and diet parameterisations under RCP 8.5 there was a moderate growth in average boat size (by about 50% with many of the smaller boats dropping out of the fishery) regardless of the scenario or strategy implemented. The shifts under the RCP scenarios aren't as great, but in all cases the average boat size increases by at least 20%.

Employment is dictated by fleet and vessel size as well as gear type, which means there can be strong variation across model parameterisations (Table 24). On average however, under RCP 3 and 4.5 employment drops by 10% or more unless overall productivity is high (sustainably supporting more fishing vessels), new fisheries are founded (e.g. on mesopelagics) or expanded (e.g. when squid biomass booms or costs are low), technological efficiency increases (allowing the fishery to remain attractive and active longer), or when stock status improves as a result of intensive management and higher catches are then maintained long term. Under RCP 8.5 increased employment only occurs when there is no acclimation or low compliance levels.

TRADEOFFS

When all the emissions scenarios were considered together the strongest patterns observable in the multivariate analyses were in terms of whether or not there was acclimation and then the emissions scenario (e.g PCA Figure 35). In the principal components analysis, the first principal component represents the tension between stock status and the size of the fisheries, with overall stock status and the biomass on the one end and effort and employment on the other. This axis pulls apart variation across management strategies under RCP 3 and 4.5, but does little to distinguish between emissions scenarios. The second principal component axis pulls apart the differences between the emissions scenarios, with primary production, LFI and pelagic biomass strongly aligned with positive values of this axis (RCP 3 simulations fall at that end) and catch, biodiversity, macroinvertebrate biomass and GVPUE aligned with negative values (this is where the RCP 8.5 simulations clustered), while RCP 4.5 simulations clustered around the origin of

Table 21: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SE under RCP 3

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	1.71 - 1.99	1.16 - 3.28	0.34 - 2.36	1.04 - 2.7	1.02 - 1.91
2010 coastal context - Cap ecosystem take	0.95 - 1.5	0.51 - 1.89	0.04 - 0.47	0.96 - 4.77	0.53 - 1.47
2010 coastal context - Centralised mgmt.	1.03 - 1.72	0.87 - 2.3	0.04 - 0.48	0.85 - 3.92	0.53 - 1.86
2010 coastal context - FewMPA	0.49 - 3.6	0.92 - 10.31	0.04 - 0.38	0.03 - 1.4	0.29 - 4.34
2010 coastal context - Fragmented mgmt	0.82 - 1.69	0.91 - 1.39	0.05 - 0.48	1.21 - 3.06	0.53 - 1.81
2010 coastal context - ManyMPA	0.16 - 0.82	0.84 - 3.66	0.06 - 0.84	0.09 - 2.53	0.4 - 0.83
2010 coastal context - Seasons	1.02 - 5.69	1.5 - 16.78	0.07 - 0.68	0.17 - 11.02	0.76 - 11.21
2010 coastal context - SlowAssess	1.05 - 4.34	0.53 - 14.02	0.04 - 0.48	0.39 - 3.74	0.72 - 1.46
2010 coastal context - Integrated Mgmt	1.09 - 2.49	0.56 - 1.88	0.04 - 0.47	0.96 - 4.77	0.75 - 2.77
Cumulative impacts - 2010 Status Quo	0.63 - 0.78	0.32 - 0.77	0.05 - 0.47	0.76 - 2.73	0.48 - 0.97
Cumulative impacts - Cap ecosystem take	0.64 - 2	0.36 - 4.61	0.05 - 0.47	1.2 - 4.04	0.49 - 0.96
Cumulative impacts - Centralised mgmt.	0.63 - 1.45	0.26 - 2.48	0.05 - 0.47	1.09 - 3.27	0.5 - 0.93
Cumulative impacts - FewMPA	0.04 - 0.71	0.11 - 0.79	0.05 - 0.38	0.02 - 5.5	0.26 - 0.34
Cumulative impacts - Fragmented mgmt	0.67 - 0.88	0.34 - 0.84	0.06 - 0.47	1.51 - 2.51	0.48 - 0.96
Cumulative impacts - ManyMPA	0.06 - 0.86	0.45 - 5.4	0.08 - 0.83	0.06 - 7.67	0.39 - 0.65
Cumulative impacts - Seasons	0.1 - 3.3	0.58 - 0.94	0.09 - 0.67	0.12 - 45.3	0.47 - 0.82
Cumulative impacts - SlowAssess	0.71 - 1.04	0.63 - 1.05	0.05 - 0.47	0.61 - 3.13	0.62 - 0.96
Cumulative impacts - IM	0.64 - 2	0.37 - 4.61	0.05 - 0.47	1.2 - 4.04	0.49 - 0.96
Expanded LTL fishery - IM	1.24 - 1.58	0.73 - 4.15	0.05 - 0.47	0.67 - 2.67	0.57 - 2.05
New mesopelgic fishery - IM	1.97 - 3.36	1.06 - 2.36	7.25 - 11.11	4.63 - 19	0.68 - 1.86
Extreme climate events - IM	1.15 - 2.59	0.77 - 1.79	0.08 - 1.03	7.46 - 22.05	0.6 - 1.28
Blooms - IM	1.2 - 3.19	0.38 - 1.7	0.07 - 1.04	8.58 - 26.29	0.63 - 1.46
Primary production regime shift - IM	1.05 - 2.54	0.89 - 3.06	0.08 - 1.03	0.92 - 17.2	0.59 - 2
Fish kills - IM	1.13 - 3.4	0.4 - 0.97	0.08 - 1.04	7.43 - 37.06	0.59 - 1.38
Range extensions - IM	0.98 - 6.9	0.75 - 26.08	0.04 - 0.48	0.3 - 3.38	0.7 - 1.83
Gear switching allowed - IM	0.21 - 3.74	0.02 - 9.7	0.03 - 0.3	0.05 - 0.95	0.95 - 5.97
High compliance - IM	0.81 - 1.42	0.94 - 2.68	0.04 - 0.47	0.9 - 2.2	0.55 - 1.23
Low Compliance - IM	0.69 - 1.12	0.48 - 1.27	0.04 - 0.48	0.95 - 4.98	0.57 - 1.43
Flexible fisher behaviour - IM	0.65 - 1.24	0.9 - 2.87	0.03 - 0.4	0.34 - 1.27	0.34 - 1.13
Increased fishing pressure drivers - IM	0.96 - 1.5	0.51 - 1.91	0.04 - 0.47	0.96 - 4.77	0.54 - 1.47
High Cost, Low Values - IM	0.17 - 3.18	0.05 - 8.38	0.03 - 0.33	0.03 - 1.17	0.68 - 4.59
Low Costs, High Values - IM	0.31 - 11.77	0.84 - 1.4	0.04 - 0.48	0.43 - 1.81	0.71 - 15.95
Standard Markets - IM	1.01 - 1.5	0.75 - 2.01	0.04 - 0.48	1.01 - 3.18	0.72 - 1.84
Technology Creep - IM	0.91 - 5.88	0.12 - 23.44	0.06 - 0.8	0.1 - 0.5	0.9 - 8.52
No Acclimation - 2010 coastal context - IM	0.07 - 2.82	0.05 - 0.11	0 - 0	0.13 - 0.5	1.19 - 85.79
No Acclimation - Cumulative impacts - SQ	0.07 - 2.95	0.02 - 0.06	0 - 0	0.13 - 0.49	1.2 - 27.59

Table 22: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SE under RCP 4.5

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	1.71 - 1.99	1.16 - 3.28	0.34 - 2.36	1.04 - 2.7	1.02 - 1.91
2010 coastal context - Cap ecosystem take	0.95 - 1.61	0.53 - 1.41	0.05 - 0.59	1.04 - 5.94	0.72 - 1.57
2010 coastal context - Centralised mgmt.	0.81 - 1.82	0.9 - 1.49	0.05 - 0.59	0.92 - 4.82	0.52 - 1.96
2010 coastal context - FewMPA	0.47 - 1.77	0.97 - 4.65	0.05 - 0.46	0.03 - 1.29	0.36 - 4.32
2010 coastal context - Fragmented mgmt	0.79 - 1.79	0.95 - 1.32	0.06 - 0.59	1.28 - 3.74	0.52 - 1.91
2010 coastal context - ManyMPA	0.16 - 0.82	0.88 - 3.8	0.08 - 1.03	0.11 - 2.34	0.39 - 0.81
2010 coastal context - Seasons	1.01 - 3.05	1.6 - 7.7	0.09 - 0.82	0.17 - 10.24	0.55 - 11.16
2010 coastal context - SlowAssess	1.12 - 2.19	0.55 - 6.32	0.05 - 0.59	0.4 - 4.63	0.7 - 1.56
2010 coastal context - Integrated Mgmt	0.95 - 1.61	0.58 - 1.4	0.05 - 0.59	1.04 - 5.94	0.72 - 1.57
Cumulative impacts - 2010 Status Quo	0.63 - 84.34	0.32 - 0.8	0.06 - 0.58	0.82 - 3.52	0.47 - 102.8
Cumulative impacts - Cap ecosystem take	0.62 - 2.07	0.36 - 4.61	0.07 - 0.57	1.25 - 5.27	0.47 - 1.05
Cumulative impacts - Centralised mgmt.	0.62 - 1.52	0.26 - 2.48	0.06 - 0.58	1.13 - 4.24	0.49 - 1.02
Cumulative impacts - FewMPA	0.04 - 0.67	0.14 - 0.8	0.06 - 0.46	0.02 - 4.99	0.26 - 0.37
Cumulative impacts - Fragmented mgmt	0.65 - 0.96	0.34 - 0.82	0.07 - 0.58	1.55 - 3.25	0.47 - 1.05
Cumulative impacts - ManyMPA	0.07 - 0.84	0.46 - 5.51	0.1 - 1.01	0.07 - 6.89	0.38 - 0.7
Cumulative impacts - Seasons	0.1 - 3.17	0.69 - 0.96	0.11 - 0.81	0.12 - 41.3	0.46 - 0.9
Cumulative impacts - SlowAssess	0.68 - 1.12	0.6 - 1.06	0.06 - 0.58	0.6 - 4.06	0.61 - 1.05
Cumulative impacts - IM	0.61 - 2.07	0.37 - 4.61	0.07 - 0.57	1.25 - 5.27	0.47 - 1.05
Expanded LTL fishery - IM	1.03 - 1.63	0.76 - 2.31	0.06 - 0.58	0.72 - 3.17	0.53 - 2.13
New mesopelgic fishery - IM	3.08 - 119.72	1.01 - 2.43	2.11 - 1745.89	5.12 - 25.26	0.61 - 1.94
Extreme climate events - IM	1.27 - 3.06	0.94 - 1.83	0.1 - 1.29	8.27 - 29.38	0.57 - 1.39
Blooms - IM	1.3 - 3.44	0.44 - 1.75	0.09 - 1.3	9.53 - 35.16	0.57 - 1.57
Primary production regime shift - IM	1.07 - 2.76	1.18 - 3.2	0.1 - 1.3	1.09 - 18.6	0.56 - 2
Fish kills - IM	1.25 - 4.37	0.47 - 1.16	0.1 - 1.3	8.25 - 49.75	0.56 - 1.49
Range extensions - IM	1.06 - 3.28	0.77 - 11.69	0.05 - 0.59	0.31 - 4.22	0.69 - 1.92
Gear switching allowed - IM	0.22 - 1.51	0.02 - 4.28	0.04 - 0.36	0.05 - 0.92	0.46 - 5.97
High compliance - IM	0.84 - 1.53	0.97 - 1.65	0.05 - 0.58	0.96 - 2.36	0.54 - 1.34
Low Compliance - IM	0.65 - 1.23	0.5 - 1.3	0.06 - 0.6	1.01 - 6.23	0.55 - 1.54
Flexible fisher behaviour - IM	0.53 - 1.3	0.98 - 1.62	0.03 - 0.5	0.37 - 1.55	0.32 - 1.18
Increased fishing pressure drivers - IM	0.8 - 1.61	0.53 - 1.42	0.05 - 0.59	1.04 - 5.94	0.5 - 1.57
High Cost, Low Values - IM	0.18 - 1.29	0.06 - 3.76	0.03 - 0.39	0.03 - 1.09	0.29 - 4.58
Low Costs, High Values - IM	0.32 - 1.68	0.87 - 1.26	0.05 - 0.59	0.51 - 1.95	0.5 - 1.73
Standard Markets - IM	0.8 - 1.59	0.74 - 1.42	0.05 - 0.59	1.1 - 3.91	0.51 - 1.94
Technology Creep - IM	0.92 - 2.8	0.13 - 10.48	0.07 - 0.98	0.1 - 0.56	0.67 - 8.52
No Acclimation - 2010 coastal context - IM	0.07 - 2.85	0.03 - 0.15	0 - 0.01	0.13 - 0.49	1.17 - 84.8
No Acclimation - Cumulative impacts - SQ	0.07 - 3.21	0.02 - 0.07	0 - 0	0.13 - 0.51	1.17 - 27.69

Table 23: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SE under RCP 8.5

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	1.71 - 1.99	1.16 - 3.28	0.34 - 2.36	1.04 - 2.7	1.02 - 1.91
2010 coastal context - Cap ecosystem take	1.87 - 182.11	2.3 - 2.57	1.84 - 1.99	5.03 - 8.74	0.73 - 243.33
2010 coastal context - Centralised mgmt.	1.56 - 1.97	1.99 - 2.79	1.84 - 1.91	4.27 - 8.45	0.7 - 0.72
2010 coastal context - FewMPA	0.93 - 7.08	1.32 - 2.3	1.44 - 1.54	0.7 - 0.83	0.43 - 8.61
2010 coastal context - Fragmented mgmt	1.59 - 2.13	1.74 - 2.8	1.85 - 2.07	6.04 - 10.56	0.7 - 0.73
2010 coastal context - ManyMPA	2.24 - 2.99	4.04 - 6.21	3.23 - 4.02	2.25 - 7.84	0.68 - 0.75
2010 coastal context - Seasons	2.01 - 2.27	2.49 - 4.13	2.27 - 2.6	5.1 - 7.06	0.86 - 0.89
2010 coastal context - SlowAssess	1.67 - 1.79	1.76 - 2.24	1.7 - 1.92	1.34 - 8.26	0.7 - 1.1
2010 coastal context - Integrated Mgmt	1.92 - 3.46	2.31 - 2.57	1.84 - 1.99	5.03 - 8.74	0.74 - 3.1
Cumulative impacts - 2010 Status Quo	1.44 - 1.72	1.31 - 2.72	1.72 - 2.21	5.11 - 7.69	0.65 - 0.67
Cumulative impacts - Cap ecosystem take	1.76 - 15.38	1.49 - 24.3	1.73 - 2.29	4.99 - 9.3	0.64 - 19.95
Cumulative impacts - Centralised mgmt.	1.53 - 20.84	1.26 - 17.59	1.7 - 2.19	4.24 - 7.24	0.63 - 24.14
Cumulative impacts - FewMPA	0.76 - 1.37	1.02 - 4.57	1.42 - 1.69	1.31 - 2.77	0.31 - 0.4
Cumulative impacts - Fragmented mgmt	1.49 - 1.72	1.29 - 2.01	1.69 - 2.38	6.51 - 8.08	0.64 - 0.69
Cumulative impacts - ManyMPA	1.73 - 6.27	2.08 - 20.71	2.96 - 4.58	4.11 - 6.74	0.67 - 0.74
Cumulative impacts - Seasons	2.52 - 4.32	1.91 - 5.74	2.26 - 2.64	9.29 - 22.55	0.55 - 2.32
Cumulative impacts - SlowAssess	1.52 - 2.28	1.93 - 5.47	1.73 - 1.96	0.9 - 6.9	0.64 - 1.01
Cumulative impacts - IM	1.58 - 5.75	1.49 - 24.3	1.73 - 2.29	4.99 - 9.3	0.64 - 0.7
Expanded LTL fishery - IM	1.5 - 2.03	2.28 - 3.36	1.83 - 1.93	3.19 - 8.01	0.7 - 0.72
New mesopelgic fishery - IM	4.94 - 7.77	0.95 - 3.97	5.02 - 21.14	27.71 - 83.64	0.75 - 0.85
Extreme climate events - IM	4.68 - 6.27	0.77 - 4.03	3.74 - 4.1	46.45 - 66.46	0.76 - 0.84
Blooms - IM	5.17 - 8.2	0.63 - 3.02	3.69 - 4.12	54.63 - 95.13	0.76 - 0.83
Primary production regime shift - IM	2.76 - 6.13	2.36 - 3.9	3.69 - 4.11	9.2 - 64.88	0.75 - 1.4
Fish kills - IM	4.93 - 7.07	0.73 - 3.87	3.73 - 4.11	46.22 - 83.07	0.76 - 0.8
Range extensions - IM	1.89 - 2.1	2.48 - 3.91	1.69 - 1.94	1.37 - 9.82	0.71 - 1.25
Gear switching allowed - IM	1.16 - 1.43	1.7 - 3.02	1.1 - 1.14	0.76 - 1.02	0.68 - 0.7
High compliance - IM	1.6 - 1.84	2.18 - 2.74	1.83 - 1.96	4.76 - 7.5	0.72 - 0.74
Low Compliance - IM	1.55 - 1.88	1.86 - 2.34	1.87 - 2.09	4.39 - 9.06	0.73 - 0.76
Flexible fisher behaviour - IM	1.17 - 1.34	2.5 - 3.9	1.57 - 1.63	1.63 - 2.65	0.56 - 0.57
Increased fishing pressure drivers - IM	1.67 - 1.92	2.3 - 2.57	1.84 - 1.99	5.03 - 8.74	0.69 - 0.74
High Cost, Low Values - IM	0.89 - 1.11	1.43 - 2.1	1.06 - 1.21	0.78 - 0.82	0.49 - 0.5
Low Costs, High Values - IM	1.95 - 14.57	2.43 - 3.64	1.84 - 2.02	5.94 - 8.34	0.69 - 17.33
Standard Markets - IM	1.49 - 2.09	1.65 - 3.05	1.85 - 1.93	4.98 - 10.11	0.7 - 0.74
Technology Creep - IM	2.12 - 2.65	3.35 - 6.69	2.74 - 3.23	1.07 - 2.89	1.13 - 1.23
No Acclimation - 2010 coastal context - IM	0.23 - 3.67	0.05 - 2.48	0.02 - 0.02	0.05 - 1.11	2.86 - 7.26
No Acclimation - Cumulative impacts - SQ	0.29 - 5.85	0.05 - 0.53	0.02 - 0.02	0.06 - 0.97	0.88 - 8.44

Table 24: Range of relative total employment in 2065-2070 (in 2065-2070) in Atlantis-SE under the different emission scenarios

Scenario	RCP 3	RCP 4.5	RCP 8.5
No Climate change - 2010 context - SQ	0.74 - 0.96	0.74 - 0.96	0.74 - 0.96
2010 coastal context - Cap ecosystem take	0.81 - 1	0.79 - 0.98	0.53 - 1.07
2010 coastal context - Centralised mgmt.	0.86 - 1.16	0.85 - 1.16	0.5 - 1.03
2010 coastal context - FewMPA	1.34 - 28.43	1.32 - 27.47	0.97 - 1.35
2010 coastal context - Fragmented mgmt	0.95 - 1.21	0.89 - 1.2	0.52 - 0.9
2010 coastal context - ManyMPA	0.42 - 18.31	0.43 - 18.31	0.48 - 0.52
2010 coastal context - Seasons	0.56 - 16.31	0.53 - 16	0.53 - 0.63
2010 coastal context - SlowAssess	0.89 - 1.18	0.86 - 1.17	0.54 - 0.88
2010 coastal context - Integrated Mgmt	0.81 - 1	0.79 - 0.98	0.53 - 1.07
Cumulative impacts - 2010 Status Quo	0.52 - 1.56	0.53 - 1.56	0.48 - 0.55
Cumulative impacts - Cap ecosystem take	0.6 - 1.09	0.6 - 1.09	0.48 - 0.64
Cumulative impacts - Centralised mgmt.	0.52 - 1.37	0.53 - 1.36	0.46 - 0.55
Cumulative impacts - FewMPA	0.73 - 49.47	0.76 - 50.53	0.75 - 1.1
Cumulative impacts - Fragmented mgmt	0.62 - 1.42	0.64 - 1.42	0.47 - 0.66
Cumulative impacts - ManyMPA	0.36 - 39.22	0.37 - 39.22	0.37 - 0.62
Cumulative impacts - Seasons	0.36 - 30.23	0.37 - 30	0.36 - 0.6
Cumulative impacts - SlowAssess	0.55 - 1.39	0.56 - 1.38	0.49 - 0.57
Cumulative impacts - IM	0.6 - 1.09	0.6 - 1.09	0.48 - 0.64
Expanded LTL fishery - IM	0.98 - 1.94	0.97 - 1.93	0.54 - 1.08
New mesopelgic fishery - IM	1.05 - 1.99	1.54 - 7.64	0.55 - 1.19
Extreme climate events - IM	0.76 - 1.04	0.74 - 1.04	0.52 - 1.06
Blooms - IM	0.77 - 1.13	0.76 - 1.12	0.53 - 0.98
Primary production regime shift - IM	1.05 - 7.03	0.98 - 6.84	0.51 - 1.08
Fish kills - IM	0.8 - 1.11	0.78 - 1.1	0.51 - 1.07
Range extensions - IM	0.98 - 1.09	0.96 - 1.09	0.51 - 1.01
Gear switching allowed - IM	0.9 - 80.59	0.89 - 77.9	0.81 - 0.91
High compliance - IM	0.73 - 2.35	0.7 - 2.31	0.49 - 0.72
Low Compliance - IM	0.57 - 4.02	0.57 - 4.02	0.52 - 0.59
Flexible fisher behaviour - IM	1.35 - 1.8	1.32 - 1.78	0.88 - 1.43
Increased fishing pressure drivers - IM	0.81 - 1	0.79 - 0.98	0.53 - 1.07
High Cost, Low Values - IM	1.15 - 97.65	1.14 - 95.11	1.18 - 1.23
Low Costs, High Values - IM	0.95 - 7.11	0.89 - 6.99	0.52 - 0.97
Standard Markets - IM	0.9 - 1.27	0.89 - 1.26	0.54 - 1.01
Technology Creep - IM	0.7 - 22.05	0.69 - 21.68	0.57 - 0.72
No Acclimation - 2010 coastal context - IM	39.92 - 84.91	38.31 - 83.45	1.07 - 104.13
No Acclimation - Cumulative impacts - SQ	39.49 - 95.64	38.03 - 93.89	1.26 - 98.85

the PCA biplot. This pattern of results highlighted both the influence of the degree of climate change and ocean acidification and how that works orthogonally to development scenarios in all but the most extreme climate change cases. It also clearly highlighted that a world without acclimation is very different to one where acclimation and evolution occur.

Within each emissions scenario the cumulative impacts cases, along with the case where there was little spatial management, group together and are clearly separated from the other cases considered (Figures 36-38). When fisheries are the major focus (i.e. the cumulative impacts of catchment and marine industries is not included) there is a lot of overlap between the management strategies and ecological scenarios (like range extensions etc). However, two small clusters are still clear (i) where there is low compliance, low costs or high value of product and (ii) where there is improved overall stock status due to extensive closures, integrated management or high compliance. These patterns are true for all the emissions scenarios with the qualification that the changed state of the system under RCP 8.5 is such that there is little to differentiate the different scenarios and management strategies apart from when there is no acclimation (which is clearly distinct). The cluster consisting of the intensive management cases (i.e. extensive closures, integrated management or high compliance) sits on the margin of the other strategies and scenarios, so while it can be identified it is not as clearly distinct as under the other emissions scenarios.

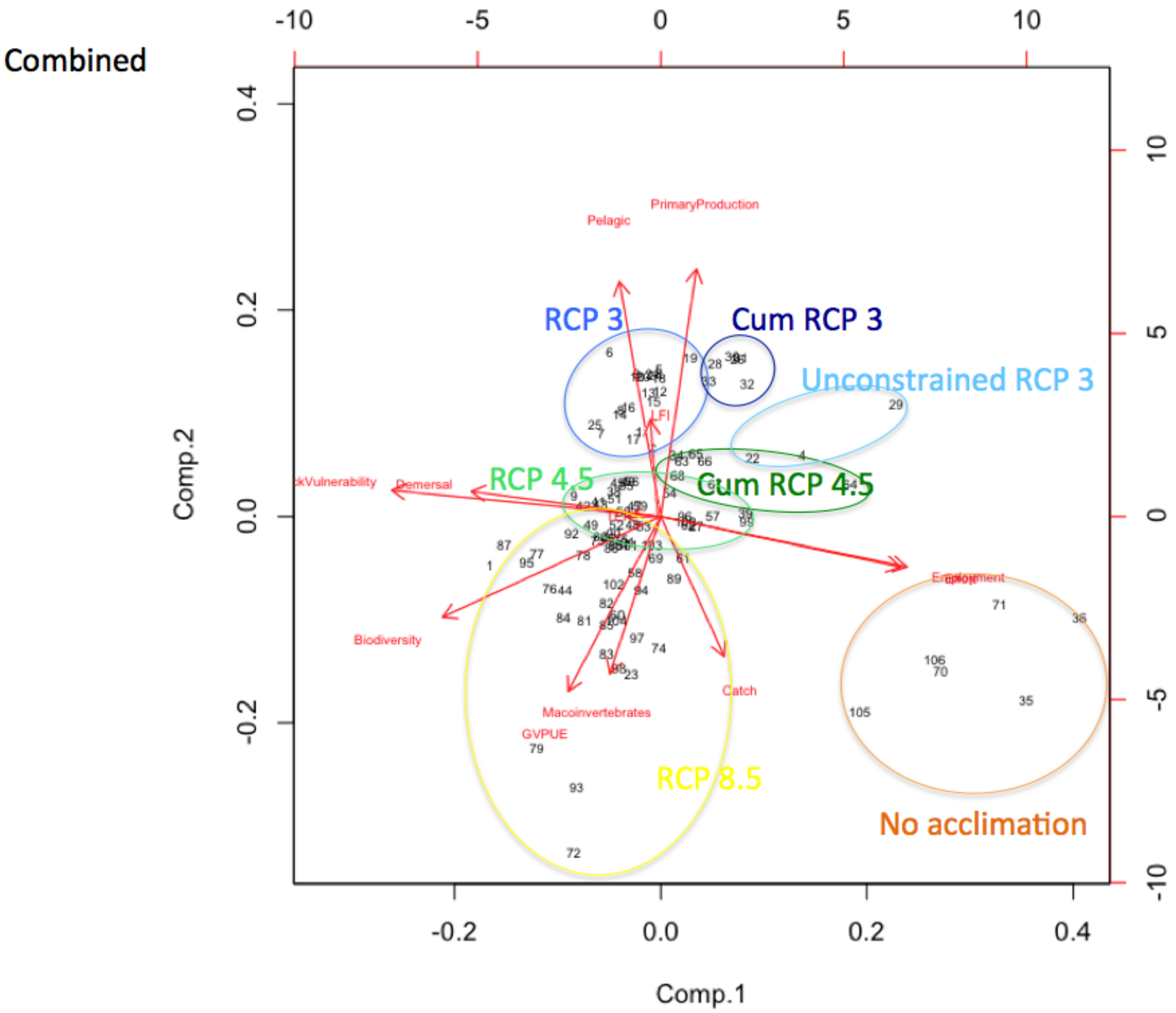


Figure 35: PCA biplot for complete set of Atlantis-SE strategies and scenarios. Small numbers are IDs for individual strategy-scenario combinations.

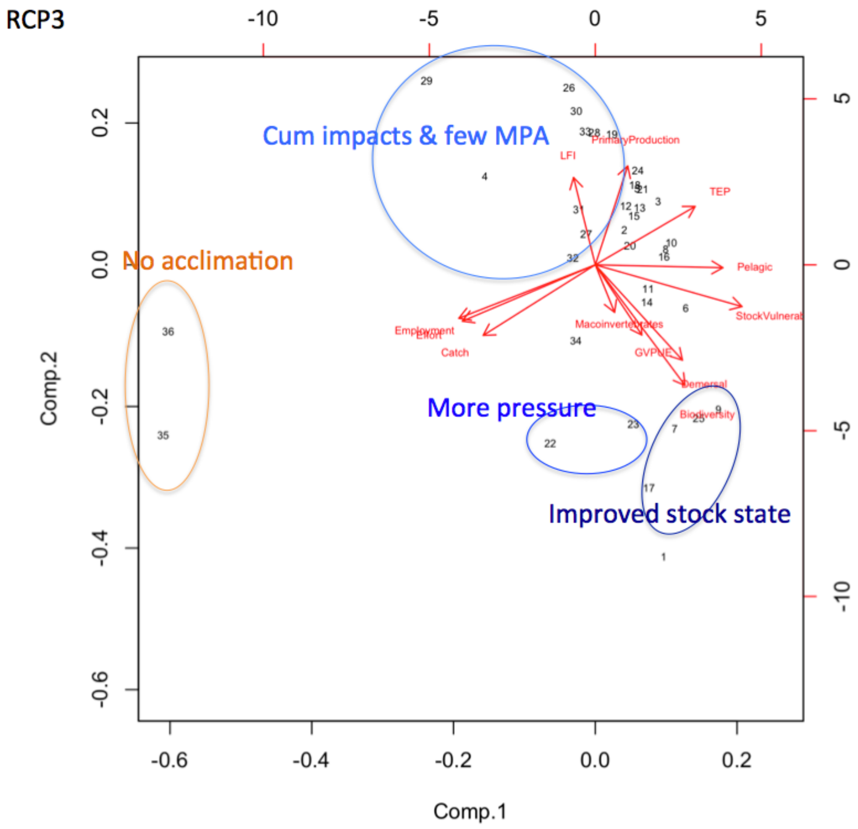


Figure 36: PCA biplot for Atlantis-SE simulations strategies and scenarios under RCP 3. Small numbers are IDs for individual strategy-scenario combinations.

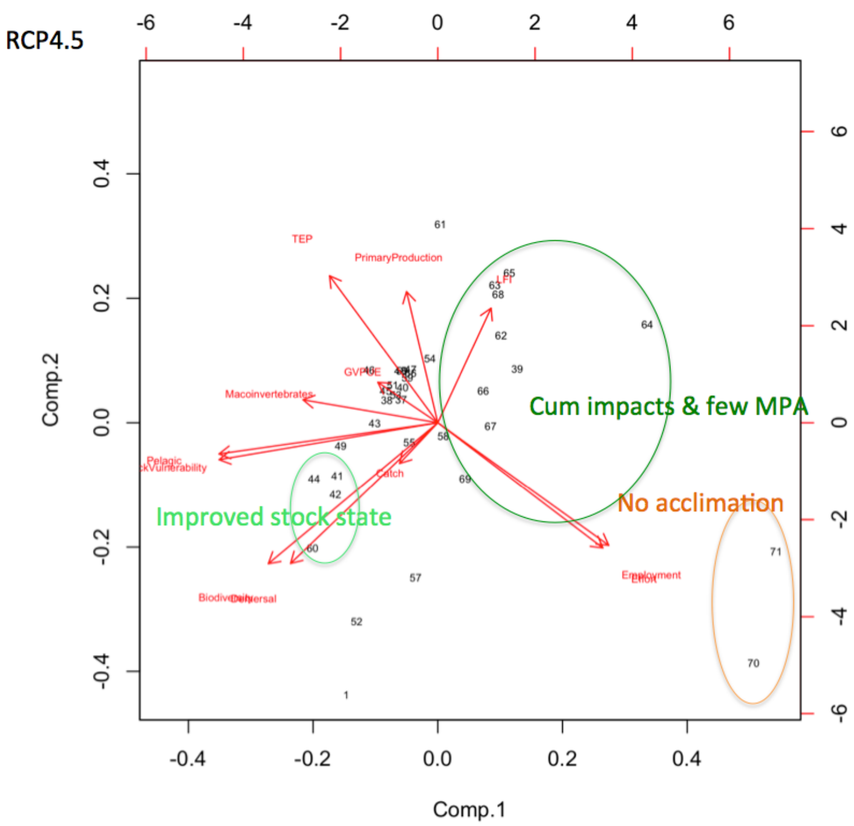


Figure 37: PCA biplot for Atlantis-SE simulations strategies and scenarios under RCP 4.5. Small numbers are IDs for individual strategy-scenario combinations.

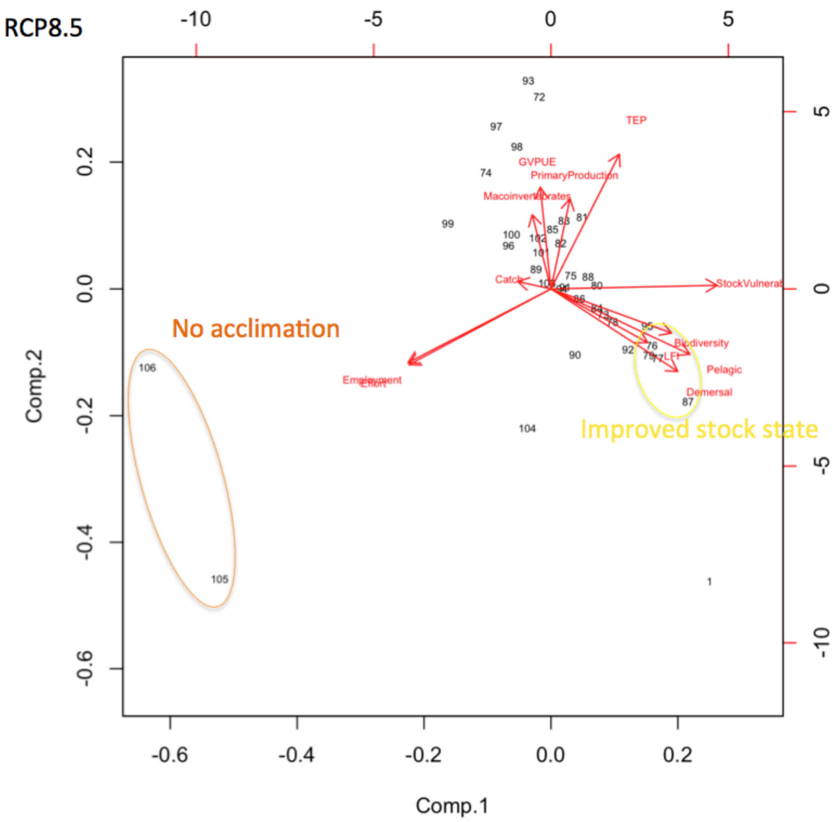
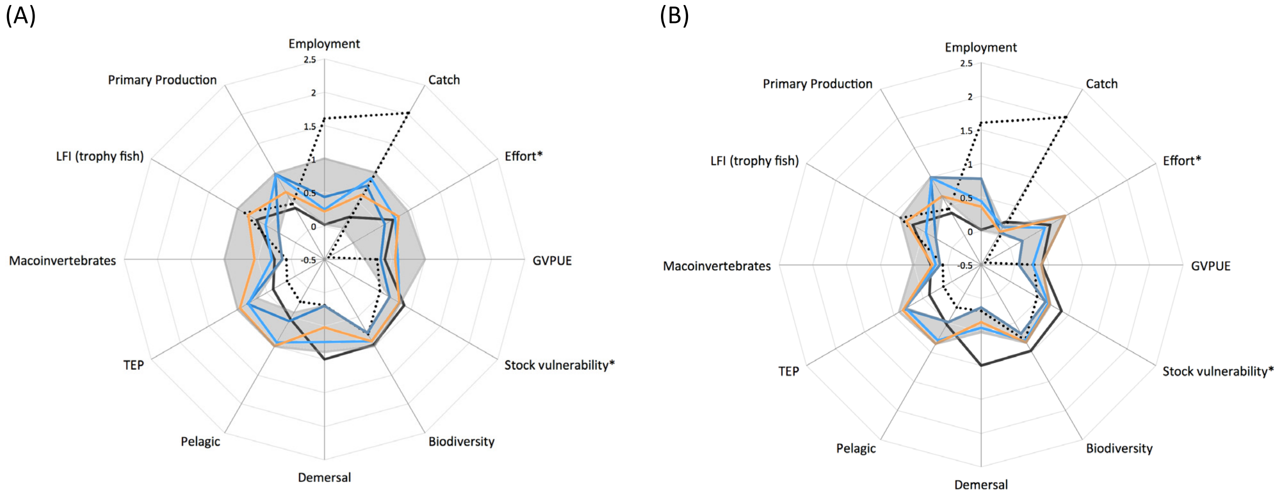


Figure 38: PCA biplot for Atlantis-SE simulations strategies and scenarios under RCP 8.5. Small numbers are IDs for individual strategy-scenario combinations.

Visualising the multidimensional trade-off space is quite challenging, but presenting a trade-off plot for every combination of parameterisation, scenario and strategy would be overwhelming to the point of being uninformative. Consequently, we used the clustering from the multidimensional analyses to group simulations with similar trade-off responses. A representative example of these responses is given in Figures 39-41. It is clear from these plots that regardless of the emissions scenario (and whether or not there are cumulative impacts of other industries) that integrated management has the most consistent performance across the kinds of objectives identified as important by stakeholders in the region. Extensive seasonal closures also perform very well against the objectives, although in reality would be quite hard to implement in practice without creating dangerous incentives, as can be seen from the short season management undertaken historically in some US fisheries. Capped effort performs roughly as well as these other two management options under RCP 8.5, but has mediocre performance under the other emissions scenarios. The poorest performing management strategy across the board is when there is minimal spatial management.

When considering how integrated management performs under ecological, environmental and fish behaviour scenarios, again there is consistency across the emissions scenarios (and parameterisations), with this management approach robust against ecological uncertainty (e.g. range extending species, shifts in productivity, fish kills etc.). Integrated management is most effective when there are high levels of compliance and its performance can be undermined if there is high market demand, low costs or other drivers for intensification of fishing pressure (as would any other management approach).



KEY

- No climate
- No acclimation
- Little spatial management
- Seasonal closures
- Integrated management

Figure 39: Trade-off plots for strategies in Atlantis-SE under RCP 3 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation) and the axes marked with a * are inverted so the larger the value the better the performance. The strategies shown represent each of the management performance clusters, except for (i) the low cost and fragmented management cases which are similar to little spatial management case, but with less catch and effort; and (ii) for sub-clusters of the "integrated management": one (made up of regime shifts, extreme events, blooms etc.) has higher primary production peaks; the high compliance case has target stock status at maximum observed values.

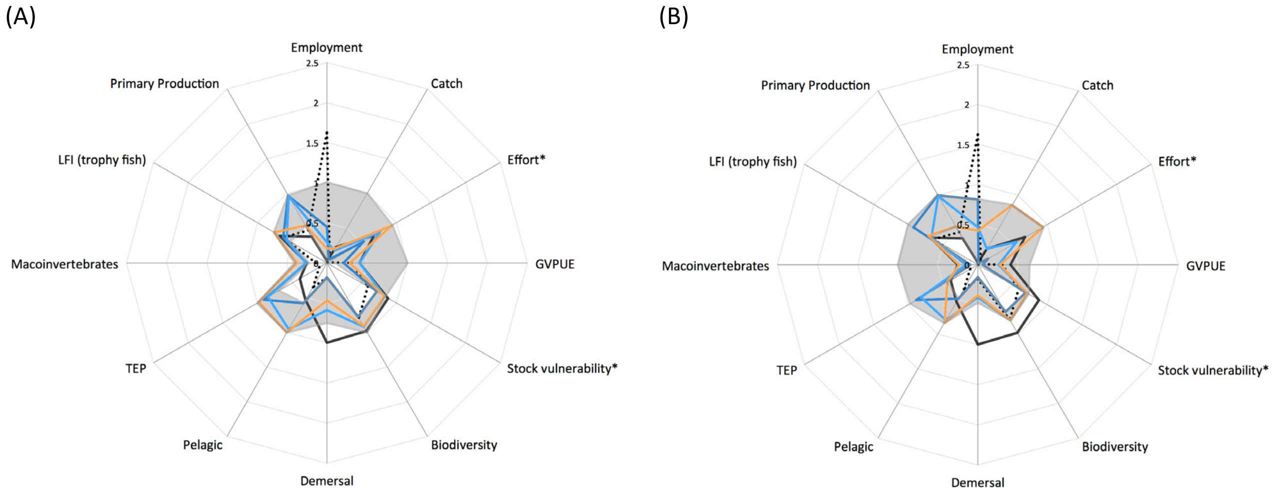


Figure 40: Trade-off plots for strategies in Atlantis-SE under RCP 4.5 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation) and the axes marked with a * are inverted so the larger the value the better the performance. The strategies shown represent each of the management performance clusters, except for ecosystem cap on landings which sits midway between the "little spatial management" and "seasonal closures" cases for all performance measures but employment which has a maximal value. Key as for Figure 39.

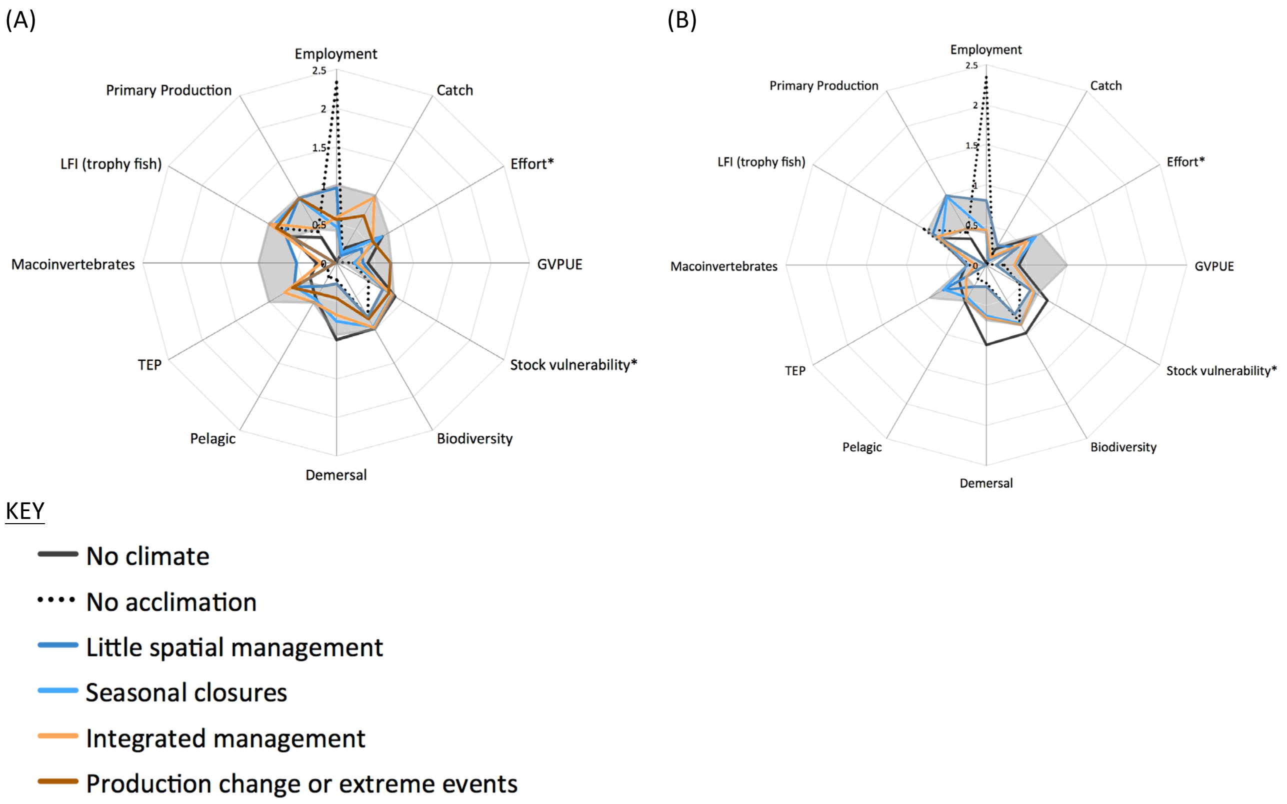


Figure 41: Trade-off plots for strategies in Atlantis-SE under RCP 8.5 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation) and the axes marked with a * are inverted so the larger the value the better the performance. The strategies shown represent each of the management performance clusters, except that the slow assessment management strategy sits midway between the "little spatial management" and "seasonal closures" cases.

INTERACTION EFFECTS

When there are multiple drivers acting on a system – climate change, ocean acidification, fisheries and other marine and coastal sectors – the influence of these different drivers can act synergistically to compound effects, but there is also the potential for them to act antagonistically (with the impacts from one driver buffering the system from impacts of another driver). An extensive analysis of the interaction effects of ocean acidification, temperature and fisheries using a variant of Atlantis-SE is described in Griffith et al (2012). That work found that climate change and ocean acidification are antagonistic in effect in the absence of fishing pressure, but that the interaction becomes synergistic once all three pressures are in play. When this work is extended to consider the broader range of emissions scenarios and the cumulative impacts of the expanded set of coastal and marine industries, there are more additive responses expressed when emissions are lower (RCP3), but that synergistic interactions still dominate and only become more common under cumulative impacts (Figure 42).

Fisheries management assumes key species are the main target species, while conservation focuses on trying to protect some proportion of all species, particularly ones thought to be vulnerable (e.g. threatened, endangered or protected species, like mammals) or have a disproportionate role in an ecosystem (e.g. some habitats). Management of other industries (e.g. catchments) aims to minimise anomalies versus unmodified states of those ecosystems (e.g. keeping pollution to a minimum). However, the groups assumed to be key players by management (targeted, exploited, vulnerable or habitat groups) did not turn out to the key players in terms of the evolution of the system under the scenarios and strategies considered here. Under RCP 3 the primary components of the basal food web resources are the key players

– i.e. plankton and deposit feeders, with picophytoplankton also identified as a broker group. Under RCP 4.5 and 8.5 there is a longer tail of potential key players, with the highest ranking ones common to these emissions scenarios, whether there is acclimation or not: cephalopods, krill, mesopelagics and picophytoplankton. All of these groups were also identified as brokers.

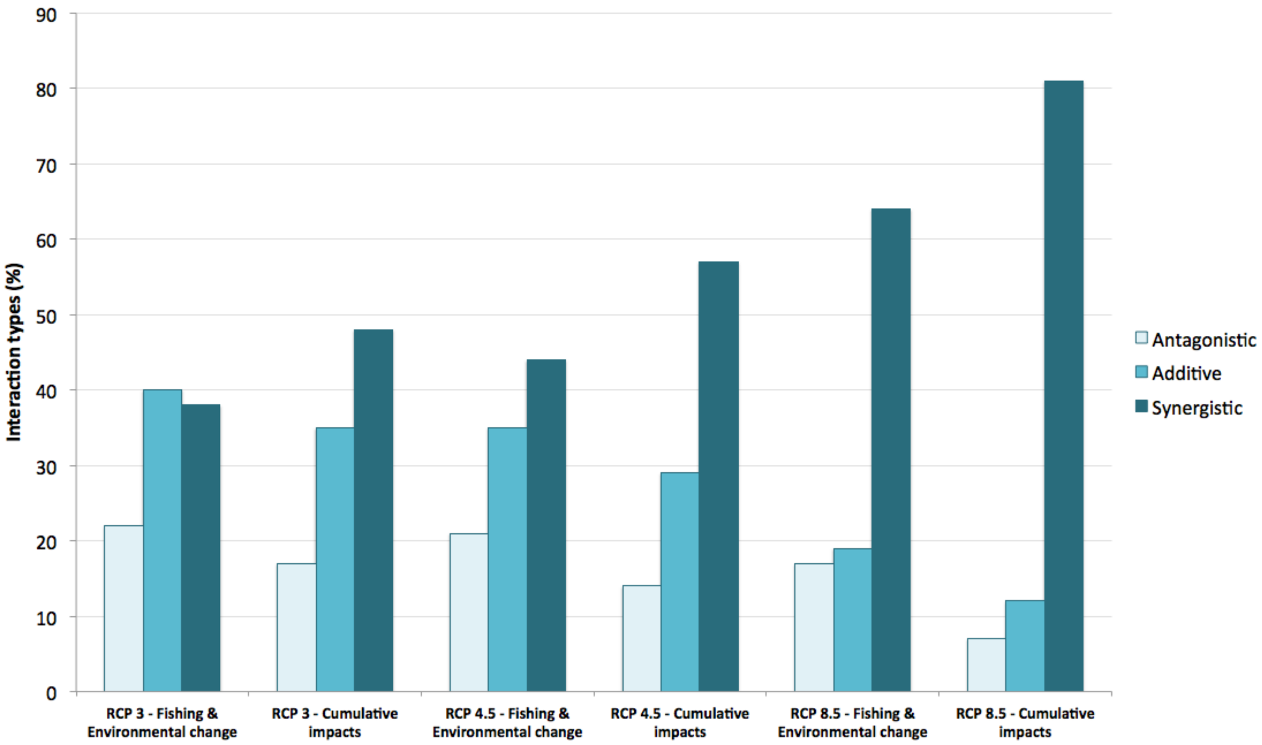


Figure 42: Interaction effects for Atlantis-SE – results for cumulative impacts and fishing and environmental drivers (with all marine industries held at 2010 levels) shown separately for each emissions scenario.

Under RCP 8.5 macrozoobenthos and mesozooplankton are also important as key players if there is acclimation, whereas shallow demersal fish, small pelagics, dories and oreos, morwong and mackerel are key players if there is no acclimation. The list of brokers is also much longer under RCP 4.5 and 8.5, indicating that these foodwebs may be susceptible to both disruption and the rapid transference of effects across the food web. Under RCP 4.5 the additional broker groups were jellyfish, shallow demersal fish, morwong, demersal sharks, seals and bacteria. Whereas under RCP 8.5 (whether or not there is acclimation) the most highly ranked additional broker species are infauna, piscivores, dories and oreos, morwong, demersal sharks and shallow demersal fish.

The length and membership of these lists of broker and key players indicates that as emissions rise more and more of the web become potential points of failure. This indicates that pressure is distributed through out the web, that no sub-webs are immune and that the food web would be under stress as it restructures in response to human use and climate and ocean acidification driven environmental shifts.

Importantly few of any of these key player or broker groups are currently considered prime fisheries targets or species typically of conservation concern.

SPATIAL EFFECTS

The aggregate results described hide a great deal of spatially nuanced outcomes. Eddy fields, upwellings, and current extensions or redirections in the underlying hydrodynamics lead to significant shifts in the physical environment which then influences primary production (Figure 43). The bloom and extreme events included in some of the simulated scenarios are spatially restricted which in turn dictates their ecological extent. For example, declines in biogenic habitat forming groups (e.g. reef forming filter feeders) affect more slope and shelf species than functional groups in deep water (and pelagics aren't effected at all). These spatially constrained events do not necessarily affect the largest of the existing fleets, as the key species involved (e.g. small pelagics afflicted by the fish kill) are not target species of those fleets nor are they significant prey items for the often demersal target species. Those fleets that target the affected groups do display more of a signature – a shift away from declining areas (if regulations and vessel characteristics permit such moves) and modest increases in activity or catch during bloom periods.

(A) (B)

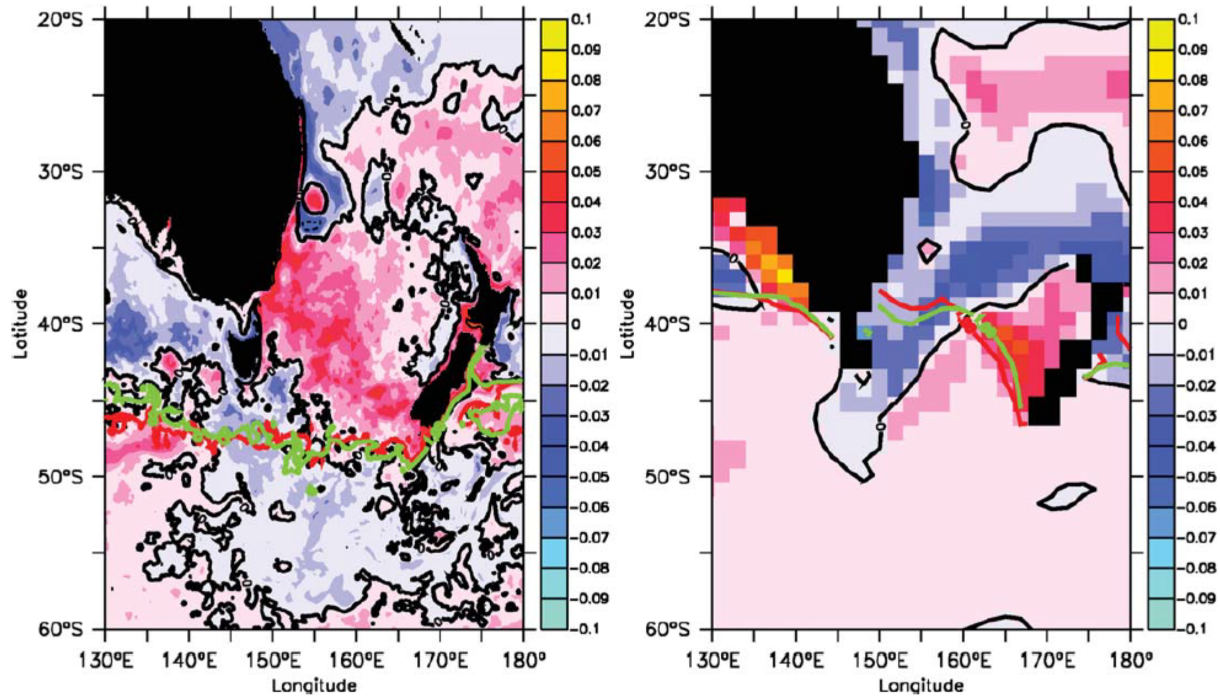


Figure 43: Change in annual mean potential productivity (mmol N m^{-3}) in the upper 100m between the 2060s and 1990s for (a) the hydrodynamics model used to drive Atlantis-SE and Atlantis-SEAP and a coarser scale general circulation model (from Matear et al 2013). Note (i) that Atlantis derives its productivity within the model but the eddy field underlying these maps is the same one used in Atlantis and thus you get the same hotspots of productivity; and (ii) the differing location of the hotspot between the fine and coarse scale hydrodynamics models.

As would be expected, larger scale environmental and ecological shifts (e.g. a persistent step change in productivity) have widespread effects on the southeast region of Australia. If, for instance, future currents, winds and water column properties lead to a decrease in upwelling off Tasmania and the Bonnie coast and less nutrient availability across the region (e.g. due to increased water column stratification) then there would be a broad scale drop in productivity. As a result, some components of the classic large phytoplankton based food web are depressed, while there is an increase in the biomass of members of an alternative food web that feeds off lower productivity, small phytoplankton based, pathways. These ecological shifts result in shifts (to varying degrees depending on the fleet) of what is fished, the most active fishing grounds and the ease of catching and landing the desired amount of product. The shift in fishing grounds is because of shifts in the spatial distribution of target species or because fleets switch which groups they target (with the new species occupying different locations). If the latter occurs, the original target groups are not typically abandoned completely, but become byproduct species instead – as gemfish has in reality. This shift in targeting can have the coincident outcome that the quotas for the original target, now byproduct, species are often reduced. While these quotas can go unfilled in some cases (e.g. where the group has low value or spatial management completely excludes access to their new spatial locations) it is possible for relative pressure to remain high on these groups if bycatch quotas are used by fishers to allow some degree of targeting – which most often occurs if the species is caught with a still productive companion species. This occurs for school sharks – that are caught with gummy sharks, which are not as impacted by ocean warming or acidification under RCP 8.5 – and blue-eye trevalla and blue warehou under RCP 3, as they decline when pink ling increases.

It is obvious that spatial management options will see different spatial outcomes, especially for groups with low levels of dispersal. However, even non-spatial management can have a spatial footprint. For example, in comparison to status quo (as of 2010) management regulations, the implementation of seasonal closures allow for more stable biomass distributions, model-wide stock levels for target species and more consistent catches spatially through time. This is because this management strategy allows for a more dispersed footprint for the catch and effort across all the offshore and many of the shelf-based fleets. Low costs also lead to dispersed fisheries footprints. In contrast, increased costs (e.g. via reduced fuel subsidies or increased taxes) see all fleets stay closer to port, meaning there is substantially less pressure on slope and deep water groups and a contraction of effort in the Great Australian Bight back toward eastern waters.

Shifts in current flows and upwelling can create spatial mosaics, but fisher behaviour in response to shifted spatial distributions, productivity patterns or regulation can also lead to shifts in spatial outcomes. Increased fisher flexibility (i.e. when decisions made are more heavily weighted to current rather than past events) lets them chase available, high CPUE sites and high value groups. This means that individual vessels are economically better off. In terms of stock status increased flexibility in fisher behaviour does not automatically lead to poorer stock status depending on the management strategy. Stocks continue to remain healthy under integrated management, but degrade if there is increase fishing pressure or little spatial management – as the target species that now no longer benefit from lags in the human decision making processes (i.e. they have lost spatiotemporal refuges). Gear switching behaviour is another human action that is not universally beneficial or destructive for target species (or catches). If fisheries management is not particularly restrictive (e.g. if non-compliance is commonplace an unaccounted for in the assessment process), or if some gears are under less regulated or have technological advantages then all spatial areas can be affected (with significant negative biomass implications). However, if integrated management is in place then there can be differential outcomes across species and locations, with slope species living in less frequently fished locations increasing as they are only periodically fished.

Atlantis-SEAP

STOCK STATUS

The average relative biomass of the final five years of each scenario-strategy combination for Atlantis-SEAP can be found in Tables A.7-A.9. While there was again strong non-linearity across the emissions scenarios, the alternative parameterisations of this model lead to a lot more uncertainty about potential outcomes. Even for the simulations where 2010 management remained in place indefinitely and there was no shift n environmental conditions the alternative parameterisations could lead to vastly different end points for some groups – demersal fish, for example, decrease by as much as 74 % in some simulations, but increase by five fold in others. On average with no climate change 46.3% (± 11.3%) of all groups increase by more than 40%, while 26% (± 13.2%) decrease by 40% or more. Across the different management strategies the percentage of groups increasing in biomass is little changed under RCP 3 (40-45% increase by >40%), unless there is no acclimation when this drops to 30-35%. The percentage of groups decreasing in biomass by >40% is larger under RCP 3 than when there is no climate change, with the percentage growing from 30-35% under effective management to as much as 43.5% (± 10.3%) under cumulative impacts and little spatial management. It grows further still to 50-52% when there is no acclimation. The average percentage of groups declining in biomass under RCP 4.5 is not substantially higher at 25-35%, although the percentage of groups increasing in biomass is at 55-65%. However, this is a very variable and uncertain outcome as the confidence bands on this are quite broad. For example under status quo management, which is indicative of variability seen under the other strategies, 58.2% (± 28.9%) increased in biomass by more than 40%, while 29.4% (± 19.6%) decreased by 40% or more. While the percentages of groups changing in biomass was still high under RCP 8.5 (with 40-55% increasing and 22-44% decreasing by more than 40% if acclimation was allowed for) the variability was an order of magnitude lower. Without acclimation variability was still low under RCP 8.5, but far fewer groups increased in biomass (only 30-35%) and many more groups decreased (48-52%).

The variability makes it much harder to characterise typical responses per functional group, but there are some with consistent tendencies (Table 25). It is clear from Table 25 that many groups can show an increase in biomass. Given the demersal nature of south east Australia's shelf ecosystems this may be surprising, but it is driven by two mechanisms. The first is the increase in biomass by groups who are range shifting with more of their stocks present in the southeastern region (e.g. stripey tuna). This is also what is

Table 25: Characterisation of clear relative biomass response of groups in Atlantis-SEAP to climate change, development and management scenarios and their potential cumulative impacts. Groups not listed either did not increase (decrease) by > 20% or had variable responses (i.e. dependent on parameterisation)

Emissions scenario	Management & Developments	Increasing biomass		Decreasing biomass	
RCP 3	Intensive or integrated	large planktivores large piscivores deep demersals spiky dogfish macrozoobenthos kelp picophytoplankton meiobenthos	shallow demersals shallow territorials blue throat wrasse dolphins prawns worms bacteria	flatheads pink snapper lobster crabs abalone	
	Cumulative impacts	oceanic planktivores deep demersals spiky dogfish dolphins macrozoobenthos	kelp deposit feeders worms jellies picophytoplankton	large planktivores small planktivores blue grenadier other shallow dem. skates and rays lobster abalone	morwong shallow piscivores other mesopelagics green eye dogfish urchins crabs
	Other	spiky dogfish gummy shark dolphins worms picophytoplankton	macrozoobenthos prawns kelp jellies meiobenthos	other mesopelagics myctophids urchins crabs	purple wrasse other shallow dem. lobster
RCP 4.5	Intensive or integrated	oceanic planktivores large piscivores spiky dogshark diatoms meiobenthos	deep demersals striped tuna prawns bacteria	Flatheads abalone	
	Cumulative impacts	oceanic planktivores large piscivores spiky dogshark gummy shark meiobenthos	deep demersals striped tuna diatoms bacteria	abalone other mesopelagics flatheads	
	Other	small planktivores oceanic planktivores striped tuna spiky dogshark meiobenthos	large piscivores deep demersals prawns diatoms bacteria	myctophids flatheads shallow piscivores abalone	
RCP 8.5	Intensive or integrated	oceanic planktivores shallow demersals large piscivores shallow territorials demersal sharks cephalopods prawns kelp	deep demersals shallow demersals blue throat wrasse striped tuna spiky dogshark macrozoobenthos deposit feeders worms	shallow piscivores myctophids abalone crabs	flatheads pelagic sharks deep filter feeders copepods

Emissions scenario	Management & Developments	Increasing biomass		Decreasing biomass	
		seagrass meiobenthos	bacteria		
	Cumulative impacts	large piscivores deep demersals shallow demersals blue throat wrasse striped tuna demersal sharks deposit feeders Meiobenthos detritus	spiky dogshark macrozoobenthos prawns kelp seagrass worms picophytoplankton bacteria	large planktivores small planktivores banded morwong pink snapper pelagic sharks urchins deep filter feeders copepods	shallow piscivores flatheads other shallow dem. green eye dogfish gummy shark abalone crabs
	Other	small planktivores large piscivores deep demersals gummy shark seabirds deposit feeders worms picophytoplankton meiobenthos	striped tuna spiky dogshark baleen whales macrozoobenthos prawns kelp seagrass bacteria	shallow piscivores myctophids pelagic sharks deep filter feeders copepods	flatheads urchins abalone crabs
No acclimation		seagrass spiky dogshark		shallow demersals flatheads pink snapper pelagic sharks dolphins lobster other shallow dem. other filter feeders deep filter feeders	myctophids purple wrasse green eye dogfish urchins orcas diatoms abalone demersal sharks

driving the increase in biomass of aggregated groups like shallow demersal fish. The degree to which the parameters for this group shifted indicate that biodiversity is at play, with range shifting species increasing the biomass rather than a growth in biomass of the species initially used to parameterise the group. In addition to this mechanism there is a general increase in productivity, which increases by 1.5-2-fold under RCP 3 and 8.5, but potentially increases by an order of magnitude under RCP 4.5. This productivity to increase passes more through the small phytoplankton based or macrophyte food webs. A significant proportion of this production directed into the microbial and detrital webs, but the remainder can still be more directly accessed and leads to increases in the biomass of groups which access these food web pathways – primarily pelagics, cephalopods, softer bodied zoobenthos and their predators.

When considering the patterns at the aggregate level (i.e. for demersal fish, sharks, bivalves etc.) the parameterisation again dominates the outcomes (Tables 26-28). Primary production increases in almost every simulation, as do infauna (unless there is no acclimation), jellyfish and large pelagics (e.g. tuna). For the more variable groups (e.g. demersal or forage fish) the greatest potential increases are seen under RCP 4.5 with gains under RCP 3 typically an order of magnitude lower and any gains under RCP 8.5 typically lower still. For some of the threatened, endangered or protected groups (TEPs), such as pelagic sharks conditions under RCP 8.5 can see reversal of stock improvements possible under lower emissions scenarios. The groups that appear to be most negatively impacted under the emissions scenarios are the bivalves and other filter feeding or herbivorous invertebrates, which show biomass reductions in all cases except for the high productivity parameterisation under RCP 4.5. For instance, abalone does not survive cumulative impacts under any circumstances. Even more generally the greatest perturbation of the stocks is under cumulative impacts, which can see substantial shifts in biomass (e.g. up to 90% drop in demersal fish biomass at one extreme, but a 2000x increase in cephalopod biomass).

Table 26: Range of change (by 2065-2070) in broad classes of functional groups in Atlantis SEAP under the RCP 3 emissions scenario

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
No Climate change - 2010 context - SQ	0.26 - 5.55	5.59 - 11.68	0.7 - 2.72	0.41 - 0.64	0.78 - 1.32	6.01 - 6.36	1.13 - 1.53	0.44 - 0.56
2010 coastal context - Cap ecosystem take	0.27 - 4.28	4.6 - 29.11	0.46 - 1.28	0.75 - 4.18	1.04 - 1.07	0.6 - 3.96	0.41 - 1.57	0.3 - 0.84
2010 coastal context - Centralised mgmt.	0.63 - 6.14	4.93 - 29.42	0.49 - 1.21	0.8 - 4.92	0.67 - 1.07	0.7 - 4.75	0.06 - 1.87	0.26 - 0.85
2010 coastal context - FewMPA	0.19 - 2.99	4.88 - 23.19	0.41 - 0.97	0.51 - 2.7	0.47 - 0.74	0.43 - 4.47	0 - 0.02	0.22 - 0.67
2010 coastal context - Fragmented mgmt	0.36 - 3.74	4.95 - 29.01	0.43 - 1.19	0.76 - 4.81	0.67 - 1.07	0.52 - 4.53	0.5 - 0.82	0.26 - 0.84
2010 coastal context - ManyMPA	1.27 - 12.42	5.09 - 30.57	0.73 - 3.56	0.46 - 4.04	0.72 - 1.12	0.55 - 3.96	3.74 - 9.56	0.27 - 0.86
2010 coastal context - Seasons	1.28 - 6.85	4.98 - 29.61	0.73 - 3.68	0.55 - 1.34	0.72 - 1.11	0.57 - 3.66	3.68 - 9.59	0.27 - 0.86
2010 coastal context - SlowAssess	1.61 - 5.06	3.5 - 29.31	0.85 - 2.84	0.3 - 1.66	0.81 - 1.47	0.84 - 5.24	0.57 - 12.68	0.3 - 1.18
2010 coastal context - Integrated Mgmt (IM)	0.81 - 9.4	5.63 - 27.6	1.71 - 32.3	0.18 - 0.65	0.98 - 1.73	2.31 - 13.25	1.58 - 9.7	0.59 - 1.07
Cumulative impacts - 2010 Status Quo (SQ)	0.27 - 5.11	3.48 - 5.42	0.48 - 2.83	0.25 - 0.51	0.6 - 0.97	1 - 5.05	0.07 - 2.42	0.35 - 0.87
Cumulative impacts - Cap ecosystem take	0.25 - 5.36	2.14 - 5.46	0.85 - 39.22	0.22 - 0.51	0.97 - 0.99	1.14 - 4.29	0.07 - 5.49	0.69 - 0.87
Cumulative impacts - Centralised mgmt.	0.29 - 7.07	3.46 - 5.52	1.05 - 7.9	0.25 - 0.49	0.62 - 0.99	1.33 - 5.15	0.09 - 8.6	0.35 - 0.88
Cumulative impacts - FewMPA	0.12 - 3.72	3.43 - 4.33	0.27 - 0.95	0.16 - 0.34	0.43 - 0.68	0.82 - 4.84	0 - 15.26	0.31 - 0.74
Cumulative impacts - Fragmented mgmt	0.19 - 5.18	3.46 - 5.43	0.9 - 6.22	0.24 - 0.49	0.62 - 0.98	0.99 - 5.54	0.04 - 94.84	0.35 - 0.87
Cumulative impacts - ManyMPA	0.35 - 9.91	3.58 - 5.75	0.91 - 154.58	0.23 - 0.47	0.68 - 1.04	1.05 - 4.44	0.44 - 17.51	0.36 - 0.89
Cumulative impacts - Seasons	0.3 - 7.26	3.5 - 5.57	0.89 - 162.56	0.17 - 0.58	0.68 - 1.02	1.1 - 3.97	0.44 - 15.02	0.36 - 0.89
Cumulative impacts - SlowAssess	0.28 - 6.46	5.11 - 7.38	0.66 - 3.31	0.48 - 3.56	0.51 - 0.97	0.51 - 5.5	0 - 7.41	0.23 - 0.87
Cumulative impacts - IM	0.4 - 7.56	2.31 - 6.75	0.61 - 81.85	0.26 - 0.53	0.52 - 0.88	1.11 - 30.61	0 - 8.53	0.35 - 1.86
Expanded LTL fishery - IM	0.78 - 6.79	4.91 - 29.39	0.52 - 3.15	0.83 - 4.45	0.69 - 1.1	0.45 - 3.95	1.01 - 9.96	0.26 - 0.85
New mesopelgic fishery - IM	0.78 - 6	4.83 - 29.37	0.69 - 1.38	0.83 - 4.45	0.69 - 1.1	0.45 - 4.03	1.01 - 9.96	0.26 - 0.86
Extreme climate events - IM	0.56 - 5.16	4.95 - 29.85	0.45 - 1.18	0.74 - 5.3	0.66 - 1.03	0.52 - 3.32	0.14 - 4.61	0.26 - 0.84
Blooms - IM	0.37 - 5.42	4.87 - 29.19	0.43 - 1.21	0.71 - 5.26	0.67 - 1.04	0.45 - 2.75	0.19 - 6.2	0.26 - 0.84
Primary production regime shift - IM	0.48 - 10.04	4.76 - 29.12	0.43 - 1.29	1.07 - 5.14	0.66 - 1.15	0.41 - 2.9	1.18 - 3.22	0.26 - 0.84
Fish kills - IM	0.45 - 6.24	5.03 - 29.27	0.44 - 1.12	0.73 - 5.18	0.65 - 1.05	0.52 - 4.43	0.32 - 2	0.26 - 0.84
Range extensions - IM	0.43 - 3.77	4.65 - 28.83	0.4 - 1.26	0.73 - 4.68	0.67 - 1.04	0.64 - 6.05	0.3 - 6.83	0.26 - 0.85
Gear switching allowed - IM	1.23 - 9.82	4.84 - 30.38	0.71 - 3.57	0.83 - 4.31	0.72 - 1.1	0.51 - 3.66	3.65 - 9.5	0.27 - 0.86
High compliance - IM	0.33 - 9.13	4.97 - 29.24	0.49 - 1.18	0.8 - 4.99	0.64 - 1.08	0.59 - 6.05	0.63 - 1.83	0.26 - 0.85
Low Compliance - IM	0.43 - 4.25	4.93 - 29.75	0.4 - 1.11	0.68 - 3.48	0.66 - 1.03	0.44 - 3.81	0.04 - 1.62	0.26 - 0.81
Flexible fisher behaviour - IM	0.77 - 3.93	4.97 - 28.75	0.48 - 1.4	0.75 - 5.09	0.67 - 1.05	0.5 - 3.75	0.61 - 10.33	0.26 - 0.85

Scenario	Demersal Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
Increased fishing pressure drivers - IM	0.45 - 6.61	4.95 - 28.87	0.46 - 1.19	0.7 - 5.18	0.65 - 1.04	0.52 - 4.66	0.18 - 2	0.26 - 0.84
High Cost, Low Values - IM	0.84 - 3.37	5.04 - 30.28	0.73 - 3.79	0.41 - 0.95	0.73 - 1.12	0.58 - 2.99	3.74 - 72.06	0.27 - 0.86
Low Costs, High Values - IM	0.08 - 5.07	1.41 - 29.33	0.47 - 1.44	0.79 - 3.17	1.05 - 1.48	0.55 - 3.25	0.63 - 10510.63	0.3 - 0.84
Standard Markets - IM	0.45 - 7.31	4.95 - 28.87	0.46 - 1.12	0.7 - 5.18	0.65 - 1.04	0.52 - 4.66	0.18 - 2	0.26 - 0.84
Technology Creep - IM	0.64 - 4.42	5.04 - 29.63	0.74 - 3.27	0.78 - 4.71	0.71 - 1.11	0.47 - 5.84	2.27 - 8.57	0.27 - 0.86
No Acclimation - 2010 coastal context - IM	0.11 - 2.3	0.82 - 16.87	0.12 - 0.52	0.06 - 1.48	0.12 - 0.17	0.65 - 8.48	0.13 - 0.67	0.11 - 0.45
No Acclimation - Cumulative impacts - SQ	0.05 - 1.64	1.5 - 42.61	0.34 - 2.11	0.1 - 5.65	0.17 - 0.18	0.1 - 3.23	0 - 16.77	0.11 - 0.39

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	3.27 - 3.52	0.62 - 1.15	0.92 - 0.98	1.2 - 1.25	2.66 - 2.97	11.77 - 14.91
2010 coastal context - Cap ecosystem take	2.29 - 2.91	1.07 - 2.29	0.96 - 1.22	1.4 - 2.18	1.91 - 2.79	0.06 - 10.9
2010 coastal context - Centralised mgmt.	1.65 - 2.53	1.06 - 1.08	0.82 - 1.22	1.96 - 2.18	2.36 - 2.8	0.06 - 17.16
2010 coastal context - FewMPA	0.31 - 0.77	1.1 - 1.12	0.83 - 1.25	1.97 - 2.2	2.18 - 2.57	0.06 - 17.56
2010 coastal context - Fragmented mgmt	1.62 - 2.57	1.06 - 1.09	0.82 - 1.23	1.97 - 2.19	2.36 - 2.8	0.06 - 17.19
2010 coastal context - ManyMPA	2.27 - 3.56	1.05 - 1.07	0.81 - 1.21	1.95 - 2.16	2.38 - 2.81	0.06 - 16.75
2010 coastal context - Seasons	2.46 - 3.11	1.05 - 1.07	0.81 - 1.21	1.94 - 2.16	2.38 - 2.81	0.06 - 16.75
2010 coastal context - SlowAssess	2.49 - 7.83	1.06 - 1.09	0.67 - 0.96	1.02 - 1.96	2.59 - 2.79	0.06 - 55.5
2010 coastal context - Integrated Mgmt (IM)	3.12 - 8.3	0.32 - 1.12	0.61 - 0.9	1.9 - 2.04	2.77 - 3.57	0.52 - 105.53
Cumulative impacts - 2010 Status Quo (SQ)	0.48 - 1.5	1.15 - 1.16	0.7 - 1.01	1.39 - 1.52	2.1 - 2.4	0.53 - 57.5
Cumulative impacts - Cap ecosystem take	0.85 - 1.49	1.14 - 2.45	0.76 - 1.01	0.96 - 1.46	1.95 - 2.13	0.53 - 36.28
Cumulative impacts - Centralised mgmt.	0.51 - 1.51	1.14 - 1.16	0.69 - 1.01	1.37 - 1.51	2.11 - 2.41	0.53 - 57.1
Cumulative impacts - FewMPA	0.24 - 0.95	1.18 - 1.2	0.7 - 1.03	1.38 - 1.51	1.94 - 2.23	0.54 - 58.37
Cumulative impacts - Fragmented mgmt	0.5 - 1.49	1.14 - 1.16	0.69 - 1.02	1.38 - 1.51	2.12 - 2.4	0.53 - 57.2
Cumulative impacts - ManyMPA	0.62 - 1.7	1.13 - 1.14	0.69 - 1	1.36 - 1.49	2.12 - 2.43	0.52 - 55.78
Cumulative impacts - Seasons	0.65 - 1.67	1.13 - 1.14	0.69 - 1	1.36 - 1.49	2.12 - 2.43	0.52 - 55.77
Cumulative impacts - SlowAssess	0.25 - 1.47	1.14 - 1.17	0.85 - 1.19	1.38 - 2.25	2.11 - 2.56	0.53 - 17.96
Cumulative impacts - IM	0.3 - 1.85	0.34 - 1.2	0.69 - 1.07	0.89 - 3.86	2.23 - 2.99	4.43 - 14.01
Expanded LTL fishery - IM	1.76 - 2.65	1.06 - 1.08	0.81 - 1.22	1.96 - 2.19	2.37 - 2.81	0.06 - 17.46
New mesopelgic fishery - IM	1.76 - 2.67	1.06 - 1.08	0.81 - 1.21	1.96 - 2.19	2.37 - 2.81	0.06 - 17.46
Extreme climate events - IM	1.55 - 2.32	1.07 - 1.08	0.82 - 1.22	1.97 - 2.19	2.36 - 2.77	0.06 - 17.2

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Blooms - IM	1.59 - 2.35	1.07 - 1.08	0.82 - 1.23	1.98 - 2.19	2.36 - 2.78	0.06 - 17.13
Primary production regime shift - IM	1.5 - 2.86	1.06 - 1.09	0.82 - 1.22	1.38 - 2.19	2.36 - 3.2	0.07 - 17.24
Fish kills - IM	1.48 - 2.42	1.07 - 1.09	0.82 - 1.22	1.97 - 2.19	2.36 - 2.78	0.06 - 17.28
Range extensions - IM	1.69 - 2.34	1.07 - 1.08	0.82 - 1.24	1.97 - 2.19	2.36 - 2.78	0.06 - 17.13
Gear switching allowed - IM	2.48 - 3.1	1.05 - 1.07	0.81 - 1.21	1.95 - 2.16	2.38 - 2.81	0.06 - 16.75
High compliance - IM	1.43 - 2.6	1.06 - 1.1	0.82 - 1.22	1.95 - 2.2	2.36 - 2.8	0.06 - 17.39
Low Compliance - IM	1.63 - 2.3	1.07 - 1.09	0.82 - 1.24	1.98 - 2.21	2.36 - 2.77	0.06 - 17.3
Flexible fisher behaviour - IM	1.68 - 2.54	1.06 - 1.08	0.81 - 1.22	1.96 - 2.18	2.37 - 2.8	0.06 - 17.05
Increased fishing pressure drivers - IM	1.48 - 2.36	1.07 - 1.09	0.82 - 1.22	1.97 - 2.19	2.36 - 2.78	0.06 - 17.28
High Cost, Low Values - IM	2.76 - 3.38	1.05 - 1.07	0.81 - 1.21	1.94 - 2.16	2.38 - 2.81	0.06 - 16.74
Low Costs, High Values - IM	2.28 - 4.34	1.06 - 3.5	0.96 - 1.22	1.21 - 2.18	1.46 - 2.8	0.06 - 4.52
Standard Markets - IM	1.48 - 2.36	1.07 - 1.09	0.82 - 1.22	1.97 - 2.19	2.36 - 2.78	0.06 - 17.28
Technology Creep - IM	1.98 - 2.72	1.06 - 1.07	0.81 - 1.21	1.95 - 2.17	2.39 - 2.81	0.06 - 16.83
No Acclimation - 2010 coastal context - IM	1.04 - 2.25	0.99 - 1.66	0.77 - 1.28	0.92 - 1.64	1.03 - 1.26	0.02 - 14.61
No Acclimation - Cumulative impacts - SQ	0.5 - 1.21	0.95 - 5.7	0.83 - 1.67	1.5 - 2.72	0.83 - 1.24	0.11 - 20.46

Table 27: Range of change (by 2065-2070) in broad classes of functional groups in Atlantis SEAP under the RCP 4.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
No Climate change - 2010 context - SQ	0.26 - 5.55	1.48 - 3.63	5.59 - 11.68	0.7 - 2.72	0.41 - 0.64	0.78 - 1.32	6.01 - 6.36	1.13 - 1.53	0.44 - 0.56
2010 coastal context - Cap ecosystem take	0.26 - 120.81	1.02 - 200.44	4.47 - 1290.6	0.44 - 49.47	1.91 - 10.07	1.05 - 46.57	0.75 - 4.07	0.41 - 55.45	0.39 - 1.88
2010 coastal context - Centralised mgmt.	0.37 - 172.44	1.05 - 202.72	4.48 - 1304.42	0.47 - 62.89	1.84 - 10.98	0.67 - 46.9	0.88 - 4.57	0.06 - 1.18	0.26 - 1.87
2010 coastal context - FewMPA	0.1 - 83.58	0.97 - 159.4	4.45 - 1028.83	0.39 - 12.74	1.04 - 5.07	0.48 - 36.05	0.54 - 4.25	0 - 110.74	0.22 - 1.88
2010 coastal context - Fragmented mgmt	0.32 - 105.75	1 - 200.12	4.5 - 1286.96	0.4 - 60.41	1.64 - 10.14	0.68 - 47.1	0.65 - 5.39	0.01 - 0.69	0.26 - 1.87
2010 coastal context - ManyMPA	0.44 - 347.52	1.29 - 211.36	4.63 - 1354.98	0.72 - 88.19	1.03 - 6.32	0.73 - 48.53	0.69 - 4.32	0.07 - 6.03	0.27 - 1.88
2010 coastal context - Seasons	0.43 - 192.76	1.27 - 204.8	4.53 - 1312.76	0.72 - 92.69	1.19 - 7.69	0.73 - 48.52	0.72 - 3.67	0.08 - 6.05	0.27 - 1.88
2010 coastal context - SlowAssess	0.43 - 142.36	2.87 - 418.11	3.17 - 1299.99	2.81 - 488.02	0.31 - 10.7	0.82 - 46.91	1.35 - 5.35	0.58 - 1541.89	0.39 - 1.88
2010 coastal context - Integrated Mgmt (IM)	0.22 - 148.81	3.83 - 216.01	5.87 - 1387.7	3.48 - 18.36	0.18 - 14.37	0.94 - 49.28	2.92 - 29.78	1.59 - 1312.72	0.6 - 6.14
Cumulative impacts - 2010 Status Quo (SQ)	0.11 - 142.91	0.87 - 40.16	3.17 - 238.81	0.48 - 6.65	0.26 - 5.43	0.61 - 40.99	1.26 - 30.2	0.01 - 216.73	0.35 - 6.24
Cumulative impacts - Cap ecosystem take	0.11 - 149.96	1.2 - 43.5	2.08 - 240.74	0.88 - 11.39	0.23 - 5.71	0.98 - 41.51	1.45 - 26.61	0.05 - 273.09	0.65 - 6.24

Scenario	Demersal Fish	Pelagic Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
Cumulative impacts - Centralised mgmt.	0.12 - 197.4	1.39 - 46.9	3.15 - 243.34	1.09 - 13.76	0.26 - 6.17	0.62 - 41.82	1.69 - 29.87	0.05 - 8.7	0.36 - 6.23
Cumulative impacts - FewMPA	0.04 - 103.59	0.66 - 32.44	3.12 - 191.84	0.18 - 5.55	0.16 - 3	0.43 - 32.23	1.03 - 27.76	0.01 - 15.33	0.31 - 6.24
Cumulative impacts - Fragmented mgmt	0.1 - 145.02	1.25 - 47.2	3.16 - 239.99	0.92 - 14.67	0.25 - 5.71	0.62 - 42	1.25 - 35.23	0 - 95.26	0.36 - 6.24
Cumulative impacts - ManyMPA	0.13 - 276.56	1.27 - 85.14	3.25 - 252.83	0.94 - 56.85	0.24 - 4.28	0.68 - 43.73	1.32 - 28.26	0.28 - 52.01	0.36 - 6.24
Cumulative impacts - Seasons	0.13 - 203.16	1.24 - 81.72	3.18 - 244.95	0.91 - 54.19	0.17 - 4.92	0.68 - 43.54	1.39 - 24.01	0.28 - 51.14	0.36 - 6.24
Cumulative impacts - SlowAssess	0.13 - 180.6	1.23 - 45.6	4.66 - 242.47	0.65 - 12.39	2.04 - 6.02	0.52 - 41.8	0.65 - 35.01	0.02 - 7.98	0.23 - 6.24
Cumulative impacts - IM	0.08 - 211.1	1.41 - 89.54	4 - 95.14	0.61 - 88.6	0.29 - 6.68	0.52 - 30.46	1.4 - 194.71	0 - 21.95	0.36 - 6.82
Expanded LTL fishery - IM	0.38 - 190.7	1.08 - 202.83	4.47 - 1303.39	0.5 - 73.54	2.01 - 11.53	0.69 - 47.92	0.57 - 3.13	0.01 - 1.61	0.26 - 1.87
New mesopelgic fishery - IM	0.4 - 168.57	1.22 - 202.82	4.39 - 1303.33	0.69 - 73.03	1.77 - 11.53	0.69 - 47.92	0.57 - 3.14	0.01 - 4.62	0.26 - 1.87
Extreme climate events - IM	0.35 - 144.87	1.02 - 205.22	4.5 - 1323.49	0.43 - 58.21	1.84 - 9.99	0.67 - 45.91	0.66 - 4.91	0 - 0.86	0.26 - 1.87
Blooms - IM	0.32 - 152.16	0.99 - 200.73	4.44 - 1293.87	0.4 - 64.69	1.64 - 9.57	0.68 - 46.06	0.57 - 5.07	0.01 - 0.52	0.26 - 1.87
Primary production regime shift - IM	0.34 - 281.15	0.98 - 201.46	4.33 - 1291.4	0.41 - 53.15	1.67 - 16.98	0.66 - 49.8	0.51 - 4.36	0 - 3.23	0.26 - 1.88
Fish kills - IM	0.33 - 175.18	1.02 - 201.6	4.58 - 1298.66	0.42 - 50.35	1.64 - 9.96	0.66 - 46.29	0.66 - 4.87	0 - 0.76	0.26 - 1.88
Range extensions - IM	0.25 - 106.57	0.94 - 198.8	4.24 - 1278.56	0.38 - 65.89	3.56 - 9.82	0.68 - 46.24	0.81 - 4.71	0.01 - 1.16	0.26 - 1.88
Gear switching allowed - IM	0.43 - 275.1	1.24 - 209.85	4.4 - 1346.75	0.71 - 88.81	2.19 - 11.2	0.73 - 48.23	0.64 - 3.71	0.07 - 5.99	0.27 - 1.88
High compliance - IM	0.34 - 255.56	1.05 - 201.96	4.52 - 1296.53	0.47 - 40.23	2.01 - 11.08	0.65 - 47.19	0.79 - 4.71	0 - 1.16	0.26 - 1.87
Low Compliance - IM	0.28 - 119.7	0.97 - 204.88	4.49 - 1319.06	0.38 - 51.69	1.47 - 9.15	0.66 - 45.95	0.55 - 3.75	0 - 0.13	0.26 - 1.87
Flexible fisher behaviour - IM	0.38 - 111.02	1.05 - 198.13	4.52 - 1275.07	0.46 - 72.4	1.83 - 10.18	0.68 - 46.51	0.63 - 5.12	0.01 - 1.23	0.26 - 1.87
Increased fishing pressure drivers - IM	0.35 - 185.33	1.02 - 199.18	4.5 - 1280.08	0.44 - 50.35	1.79 - 9.42	0.66 - 46.09	0.66 - 4.62	0 - 0.93	0.26 - 1.88
High Cost, Low Values - IM	0.42 - 96.27	1.28 - 209.46	4.59 - 1342.47	0.73 - 98.93	0.42 - 6.58	0.74 - 48.59	0.73 - 3.99	0.08 - 6.05	0.27 - 1.88
Low Costs, High Values - IM	0.09 - 142.69	1.02 - 202.24	1.37 - 1301.04	0.45 - 48.59	2.04 - 10.73	1.06 - 47.05	0.85 - 3.52	0.01 - 1.05	0.66 - 1.87
Standard Markets - IM	0.35 - 204.8	1.02 - 198.62	4.5 - 1280.1	0.44 - 50.35	1.79 - 9.42	0.66 - 46.09	0.66 - 4.62	0 - 0.93	0.26 - 1.88
Technology Creep - IM	0.41 - 124.92	1.3 - 204.96	4.59 - 1314.52	0.74 - 89.51	1.74 - 10.32	0.72 - 48.17	0.6 - 4.59	0.04 - 5.41	0.27 - 1.88
No Acclimation - 2010 coastal context - IM	0.1 - 65.54	0.65 - 115.98	0.8 - 747.47	0.28 - 9.46	0.38 - 1.87	0.13 - 5.4	1.17 - 6.6	0.01 - 0.42	0.11 - 1.75
No Acclimation - Cumulative impacts - SQ	0.04 - 47.06	0.59 - 1269.06	1.46 - 1890.35	0.32 - 1482.89	1.19 - 7.99	0.18 - 11.12	0.53 - 2.52	0 - 0.25	0.11 - 1.35

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	3.27 - 3.52	0.62 - 1.15	0.92 - 0.98	1.2 - 1.25	2.66 - 2.97	11.77 - 14.91
2010 coastal context - Cap ecosystem take	2.64 - 13.79	1.1 - 56.65	0.96 - 51.03	1.39 - 110.91	1.91 - 129.51	0.09 - 109.36

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
2010 coastal context - Centralised mgmt.	1.65 - 13.84	1.08 - 56.38	0.82 - 50.82	2.17 - 110	2.36 - 130.03	0.09 - 172.13
2010 coastal context - FewMPA	0.31 - 36.87	1.11 - 58.44	0.83 - 51.99	2.18 - 110.91	2.18 - 119.9	0.09 - 176.17
2010 coastal context - Fragmented mgmt	1.61 - 13.87	1.08 - 56.34	0.82 - 50.74	2.17 - 110.94	2.36 - 130.1	0.09 - 172.44
2010 coastal context - ManyMPA	2.26 - 19.98	1.06 - 55.99	0.81 - 50.27	2.15 - 108.82	2.37 - 130.36	0.08 - 168.09
2010 coastal context - Seasons	2.46 - 16.57	1.06 - 55.98	0.81 - 50.34	2.15 - 108.88	2.37 - 130.39	0.08 - 168.1
2010 coastal context - SlowAssess	4.01 - 13.36	1.08 - 56.48	0.68 - 50.83	1.25 - 110.18	2.57 - 129.85	0.72 - 557.14
2010 coastal context - Integrated Mgmt (IM)	6.13 - 16.4	0.31 - 59.23	0.62 - 47.94	2.03 - 112.87	2.68 - 132.79	5.13 - 452.7
Cumulative impacts - 2010 Status Quo (SQ)	0.47 - 6.82	1.16 - 60.9	0.7 - 53.3	1.5 - 83.92	2.07 - 96.8	0.66 - 577.22
Cumulative impacts - Cap ecosystem take	0.85 - 6.42	1.19 - 60.69	0.76 - 53.11	0.95 - 83.6	1.95 - 97.19	0.66 - 364.19
Cumulative impacts - Centralised mgmt.	0.51 - 6.79	1.15 - 60.4	0.7 - 52.89	1.49 - 82.88	2.07 - 97.57	0.66 - 573.22
Cumulative impacts - FewMPA	0.24 - 4.15	1.19 - 62.61	0.71 - 54.1	1.49 - 83.56	1.91 - 89.94	0.67 - 585.93
Cumulative impacts - Fragmented mgmt	0.5 - 70.28	1.15 - 60.36	0.7 - 52.8	1.49 - 83.63	2.06 - 97.62	0.67 - 574.26
Cumulative impacts - ManyMPA	0.62 - 8.47	1.13 - 59.98	0.69 - 52.32	1.47 - 81.95	2.08 - 97.8	0.65 - 559.91
Cumulative impacts - Seasons	0.65 - 7.15	1.14 - 59.98	0.69 - 52.39	1.47 - 82	2.08 - 97.82	0.65 - 559.91
Cumulative impacts - SlowAssess	0.24 - 6.31	1.16 - 60.51	0.85 - 52.9	2.23 - 83.02	2.19 - 97.43	0.11 - 180.24
Cumulative impacts - IM	0.3 - 8.2	0.34 - 63.46	0.7 - 49.91	1.45 - 55.62	2.56 - 100.35	0.72 - 247.89
Expanded LTL fishery - IM	1.76 - 14.76	1.08 - 56.49	0.81 - 50.68	2.17 - 109.93	2.37 - 130.4	0.09 - 175.22
New mesopelgic fishery - IM	1.76 - 14.76	1.08 - 56.49	0.81 - 50.68	2.17 - 109.93	2.37 - 130.4	0.09 - 175.22
Extreme climate events - IM	1.55 - 12.47	1.08 - 56.95	0.82 - 51.27	2.17 - 111.45	2.36 - 128.99	0.09 - 172.56
Blooms - IM	1.59 - 12.93	1.07 - 56.87	0.82 - 51.21	2.17 - 111.87	2.36 - 129.01	0.09 - 171.92
Primary production regime shift - IM	1.5 - 15.82	1.08 - 56.14	0.82 - 48.43	2.18 - 92.56	2.36 - 148.94	0.09 - 172.96
Fish kills - IM	1.48 - 12.9	1.08 - 56.65	0.82 - 51.09	2.18 - 110.86	2.36 - 129.24	0.09 - 173.33
Range extensions - IM	1.69 - 12.15	1.08 - 56.73	0.82 - 51.08	2.17 - 110.76	2.37 - 129.29	0.09 - 171.91
Gear switching allowed - IM	2.47 - 16.01	1.06 - 55.88	0.81 - 50.34	2.15 - 108.87	2.37 - 130.42	0.08 - 168.02
High compliance - IM	1.43 - 13.61	1.09 - 56.3	0.82 - 50.67	2.18 - 109.69	2.36 - 130.17	0.09 - 174.43
Low Compliance - IM	1.63 - 12.4	1.08 - 56.98	0.82 - 51.3	2.18 - 111.59	2.35 - 128.91	0.09 - 173.54
Flexible fisher behaviour - IM	1.68 - 13.36	1.07 - 56.41	0.81 - 50.83	2.17 - 110.5	2.37 - 129.93	0.09 - 171.04
Increased fishing pressure drivers - IM	1.48 - 12.23	1.08 - 56.84	0.82 - 51.22	2.18 - 111.31	2.36 - 128.99	0.09 - 173.33
High Cost, Low Values - IM	2.76 - 18.3	1.06 - 56.01	0.81 - 50.3	2.15 - 108.8	2.37 - 130.41	0.08 - 167.95
Low Costs, High Values - IM	2.63 - 13.35	1.1 - 56.45	1.1 - 50.85	1.2 - 110.5	1.47 - 130.03	0.09 - 45.39
Standard Markets - IM	1.48 - 12.23	1.08 - 56.84	0.82 - 51.22	2.18 - 111.31	2.36 - 128.99	0.09 - 173.33

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Technology Creep - IM	1.98 - 14.56	1.06 - 56.15	0.81 - 50.47	2.15 - 109.5	2.38 - 130.55	0.09 - 168.87
No Acclimation - 2010 coastal context - IM	1.04 - 84.98	1.06 - 52.48	0.88 - 41.75	1.43 - 51.67	1.01 - 58.46	0.7 - 14647.65
No Acclimation - Cumulative impacts - SQ	0.66 - 64.08	1.21 - 50.36	1.16 - 44.33	1.88 - 82.49	0.83 - 60.17	0.22 - 20789.23

Table 28: Range of change (by 2065-2070) in broad classes of functional groups in Atlantis SEAP under the RCP 8.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
No Climate change - 2010 context - SQ	0.26 - 5.55	1.48 - 3.63	5.59 - 11.68	0.7 - 2.72	0.41 - 0.64	0.78 - 1.32	6.01 - 6.36	1.13 - 1.53	0.44 - 0.56
2010 coastal context - Cap ecosystem take	0.28 - 3.33	1.09 - 4.96	4.79 - 28.96	0.46 - 0.91	1.54 - 8.11	1.04 - 1.8	0.83 - 3.12	1.3 - 21003.02	0.25 - 0.71
2010 coastal context - Centralised mgmt.	0.84 - 4.72	1.12 - 5.02	4.82 - 29.28	0.49 - 1.22	1.71 - 9.46	1.04 - 1.1	0.93 - 3.75	0.38 - 1.99	0.25 - 0.51
2010 coastal context - FewMPA	0.24 - 2.27	1.04 - 3.97	4.77 - 23.08	0.41 - 1.04	0.41 - 4.73	0.71 - 0.78	0.86 - 3.52	0 - 1057.74	0.21 - 0.46
2010 coastal context - Fragmented mgmt	0.47 - 2.93	1.07 - 4.96	4.83 - 28.87	0.43 - 1.21	1.52 - 9.2	1.01 - 1.14	1.1 - 3.58	0.33 - 2.18	0.25 - 0.51
2010 coastal context - ManyMPA	2.1 - 9.43	1.34 - 5.27	4.97 - 30.42	0.72 - 1.48	1.18 - 7.99	1.05 - 1.18	0.88 - 3.13	4.7 - 11.88	0.25 - 0.52
2010 coastal context - Seasons	2.08 - 5.28	1.32 - 5.12	4.86 - 29.47	0.72 - 1.49	1.39 - 2.85	1.06 - 1.19	0.75 - 2.99	4.74 - 11.68	0.25 - 0.52
2010 coastal context - SlowAssess	2.46 - 5.62	1.71 - 5	3.42 - 29.17	0.92 - 2.83	1.48 - 3.35	1.06 - 1.47	1.09 - 5.59	1.82 - 2391.76	0.25 - 0.73
2010 coastal context - Integrated Mgmt (IM)	2.79 - 17.66	3.94 - 5.12	6.31 - 28.95	1.1 - 3.54	0.55 - 2.46	1.16 - 1.65	6.07 - 12.07	5.01 - 2036.28	0.6 - 1.21
Cumulative impacts - 2010 Status Quo (SQ)	0.8 - 3.88	0.89 - 1.09	3.4 - 5.4	0.31 - 0.47	0.83 - 0.94	0.94 - 0.96	3.99 - 6.15	0.07 - 6.56	0.62 - 0.63
Cumulative impacts - Cap ecosystem take	0.72 - 4.07	1.2 - 3.65	2.97 - 5.44	0.65 - 3.76	0.86 - 0.95	0.96 - 1.56	3.38 - 5.97	0.07 - 1729.86	0.63 - 1.23
Cumulative impacts - Centralised mgmt.	0.89 - 5.34	1.37 - 1.64	3.39 - 5.5	0.9 - 1.03	0.9 - 0.96	0.95 - 0.99	4.06 - 6.97	0.08 - 1855.28	0.63 - 0.63
Cumulative impacts - FewMPA	0.4 - 3.16	0.85 - 1.28	3.35 - 5	0.19 - 0.93	0.22 - 0.24	0.66 - 0.67	3.82 - 5.65	0 - 52.1	0.58 - 0.59
Cumulative impacts - Fragmented mgmt	0.5 - 3.94	1.24 - 1.7	3.39 - 5.4	0.74 - 1.08	0.85 - 0.88	0.95 - 0.98	3.88 - 7.18	0.04 - 164.19	0.62 - 0.63
Cumulative impacts - ManyMPA	1.08 - 12.22	1.27 - 13.2	3.5 - 5.73	0.89 - 14.59	0.73 - 0.96	1 - 1.04	3.39 - 5.76	0.43 - 2314.67	0.63 - 0.63
Cumulative impacts - Seasons	0.85 - 6.48	1.24 - 13.83	3.42 - 5.55	0.87 - 15.33	0.82 - 1.07	1.01 - 1.04	3.13 - 5.74	0.43 - 2352.79	0.63 - 0.63
Cumulative impacts - SlowAssess	0.37 - 4.89	1.28 - 2.42	5 - 10.26	0.65 - 1.1	0.93 - 6.6	0.82 - 0.97	1.61 - 7.13	0 - 0.25	0.39 - 0.63
Cumulative impacts - IM	1.5 - 5.71	1.47 - 7.69	2.3 - 6.59	0.61 - 8.43	0.41 - 1.35	0.7 - 0.87	4.08 - 39.66	0 - 3.55	0.57 - 1.74
Expanded LTL fishery - IM	1.13 - 5.21	1.14 - 5.04	4.8 - 29.24	0.52 - 1.43	1.81 - 8.61	1.07 - 1.15	0.64 - 3.11	0.66 - 3.19	0.25 - 0.52
New mesopelgic fishery - IM	1.13 - 4.62	1.27 - 5.04	4.71 - 29.23	0.69 - 1.26	1.81 - 8.61	1.08 - 1.15	0.64 - 3.18	0.66 - 7.17	0.25 - 0.52
Extreme climate events - IM	0.73 - 3.97	1.09 - 5.06	4.83 - 29.7	0.46 - 1.21	1.55 - 10.04	1 - 1.12	1 - 2.73	0.31 - 1.34	0.25 - 0.51
Blooms - IM	0.5 - 4.17	1.06 - 4.96	4.76 - 29.05	0.43 - 1.23	1.49 - 10.06	1 - 1.14	1.03 - 2.35	0.41 - 0.81	0.25 - 0.51
Primary production regime shift - IM	0.6 - 7.64	1.05 - 5.05	4.65 - 28.98	0.44 - 1.19	2.81 - 9.79	1.01 - 1.14	0.89 - 2.28	0.2 - 10.21	0.29 - 0.51

Scenario	Demersal Fish	Pelagic Fish	Large Pelagic Fish	Forage Fish	Sharks	Mammals	Seabirds	Cephalopod	Bivalves
Fish kills - IM	0.51 - 4.79	1.09 - 4.98	4.91 - 29.13	0.45 - 1.19	1.55 - 9.83	1.02 - 1.08	0.99 - 3.5	0.13 - 1.19	0.25 - 0.51
Range extensions - IM	0.89 - 2.94	1.01 - 4.94	4.55 - 28.69	0.41 - 1.24	1.53 - 9.07	0.88 - 1.12	0.83 - 4.77	0.46 - 1.8	0.25 - 0.52
Gear switching allowed - IM	2.11 - 7.48	1.29 - 5.22	4.73 - 30.23	0.71 - 1.48	1.67 - 8.34	1.05 - 1.21	0.76 - 2.88	4.67 - 11.58	0.25 - 0.52
High compliance - IM	0.29 - 6.95	1.12 - 5.03	4.85 - 29.1	0.49 - 1.16	1.76 - 9.5	1.03 - 1.13	0.76 - 4.77	0.04 - 2.44	0.25 - 0.51
Low Compliance - IM	0.45 - 3.29	1.04 - 5.08	4.82 - 29.6	0.41 - 1.2	1.43 - 6.89	0.96 - 1.11	0.76 - 3.01	0.04 - 0.42	0.25 - 0.5
Flexible fisher behaviour - IM	1.12 - 4.47	1.11 - 4.9	4.85 - 28.62	0.48 - 1.23	1.57 - 9.77	1 - 1.1	1.04 - 2.96	0.69 - 1.95	0.25 - 0.52
Increased fishing pressure drivers - IM	0.51 - 5.05	1.09 - 4.96	4.84 - 28.73	0.46 - 1.19	1.46 - 9.83	1.02 - 1.08	0.94 - 3.68	0.13 - 1.44	0.25 - 0.51
High Cost, Low Values - IM	2.01 - 2.69	1.33 - 5.23	4.93 - 30.14	0.72 - 1.52	1.23 - 1.89	1.05 - 1.22	0.81 - 3.02	4.8 - 11.87	0.25 - 0.52
Low Costs, High Values - IM	0.06 - 3.92	0.64 - 5.01	1.95 - 29.18	0.42 - 0.93	1.62 - 6.39	1.05 - 2.52	0.72 - 3.51	1.63 - 7001.9	0.25 - 1.23
Standard Markets - IM	0.51 - 5.58	1.09 - 4.91	4.84 - 28.73	0.46 - 1.19	1.46 - 9.83	1.02 - 1.08	0.94 - 3.68	0.13 - 1.44	0.25 - 0.51
Technology Creep - IM	1.39 - 3.45	1.34 - 5.11	4.93 - 29.49	0.74 - 1.44	1.54 - 8.96	1.06 - 1.2	0.94 - 4.61	2.75 - 8.39	0.25 - 0.52
No Acclimation - 2010 coastal context - IM	0.15 - 1.85	0.27 - 2.87	1.14 - 16.79	0.13 - 0.52	0.11 - 3.16	0.12 - 0.28	0.84 - 6.69	0.4 - 422.73	0.11 - 0.27
No Acclimation - Cumulative impacts - SQ	0.04 - 1.33	0.63 - 6.75	2.07 - 42.4	0.35 - 3.14	0.13 - 13.01	0.17 - 0.32	0.13 - 2.55	0 - 0.16	0.08 - 0.22

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
No Climate change - 2010 context - SQ	3.27 - 3.52	0.62 - 1.15	0.92 - 0.98	1.2 - 1.25	2.66 - 2.97	11.77 - 14.91
2010 coastal context - Cap ecosystem take	2.27 - 4.02	1.08 - 2.29	0.98 - 2.08	1.4 - 2.19	1.7 - 2.83	1.28 - 1.78
2010 coastal context - Centralised mgmt.	2.32 - 2.53	1.07 - 1.08	0.97 - 1.5	2.07 - 2.19	2.1 - 2.84	1.27 - 2.8
2010 coastal context - FewMPA	0.72 - 0.84	1.11 - 1.11	1 - 1.53	2.09 - 2.21	1.94 - 2.61	1.29 - 2.84
2010 coastal context - Fragmented mgmt	2.19 - 2.57	1.07 - 1.08	0.97 - 1.5	2.08 - 2.2	2.1 - 2.84	1.26 - 2.8
2010 coastal context - ManyMPA	3 - 3.57	1.07 - 1.07	0.96 - 1.48	2.06 - 2.17	2.12 - 2.84	1.25 - 2.74
2010 coastal context - Seasons	2.95 - 3.19	1.07 - 1.07	0.96 - 1.48	2.06 - 2.17	2.12 - 2.85	1.25 - 2.74
2010 coastal context - SlowAssess	2.49 - 7.79	1.07 - 1.09	0.92 - 0.98	1.05 - 2.07	2.3 - 2.83	1.27 - 12.24
2010 coastal context - Integrated Mgmt (IM)	3.13 - 8.25	0.32 - 1.13	0.69 - 0.91	1.92 - 2.09	2.77 - 3.15	11.15 - 106.69
Cumulative impacts - 2010 Status Quo (SQ)	1.36 - 1.46	1.16 - 1.16	1.02 - 1.02	1.48 - 1.49	2.13 - 2.13	11.35 - 11.41
Cumulative impacts - Cap ecosystem take	1.43 - 2.29	1.15 - 2.44	1.02 - 1.3	0.94 - 1.48	1.72 - 2.14	7.2 - 11.39
Cumulative impacts - Centralised mgmt.	1.41 - 1.48	1.15 - 1.16	1.01 - 1.02	1.47 - 1.48	2.13 - 2.14	11.2 - 11.35
Cumulative impacts - FewMPA	0.9 - 0.93	1.19 - 1.2	1.03 - 1.04	1.48 - 1.49	1.96 - 1.97	11.45 - 11.58
Cumulative impacts - Fragmented mgmt	1.4 - 1.46	1.15 - 1.17	1.01 - 1.02	1.48 - 1.49	2.12 - 2.15	11.19 - 11.47

Scenario	Crustacea	Jellies	Zooplankton	Primary Production	Infauna	Detritus
Cumulative impacts - ManyMPA	1.57 - 1.67	1.14 - 1.15	1 - 1.01	1.46 - 1.47	2.14 - 2.15	11.04 - 11.2
Cumulative impacts - Seasons	1.57 - 1.64	1.14 - 1.15	1 - 1.01	1.46 - 1.47	2.14 - 2.15	11.05 - 11.2
Cumulative impacts - SlowAssess	0.77 - 1.45	1.15 - 1.16	1.01 - 1.56	1.47 - 2.25	1.94 - 2.56	1.63 - 11.22
Cumulative impacts - IM	0.82 - 1.82	0.34 - 1.21	0.93 - 1.08	0.97 - 4.01	2.27 - 2.64	2.91 - 102.01
Expanded LTL fishery - IM	2.36 - 2.66	1.07 - 1.08	0.97 - 1.49	2.07 - 2.19	2.1 - 2.85	1.28 - 2.83
New mesopelgic fishery - IM	2.47 - 2.66	1.07 - 1.08	0.97 - 1.49	2.07 - 2.19	2.1 - 2.85	1.28 - 2.83
Extreme climate events - IM	2.24 - 2.33	1.08 - 1.08	0.98 - 1.5	2.09 - 2.19	2.09 - 2.81	1.28 - 2.81
Blooms - IM	2.19 - 2.35	1.08 - 1.08	0.98 - 1.5	2.09 - 2.2	2.1 - 2.81	1.28 - 2.8
Primary production regime shift - IM	2.18 - 2.86	1.07 - 1.08	0.92 - 1.5	1.45 - 2.2	2.09 - 3.24	1.35 - 2.81
Fish kills - IM	2.16 - 2.42	1.08 - 1.08	0.98 - 1.51	2.08 - 2.2	2.09 - 2.82	1.28 - 2.82
Range extensions - IM	2.1 - 2.39	1.08 - 1.08	0.98 - 1.5	2.08 - 2.2	2.1 - 2.82	1.28 - 2.8
Gear switching allowed - IM	2.87 - 3.2	1.06 - 1.07	0.96 - 1.47	2.06 - 2.17	2.11 - 2.85	1.25 - 2.74
High compliance - IM	2.09 - 2.6	1.07 - 1.09	0.97 - 1.51	2.07 - 2.2	2.09 - 2.84	1.26 - 2.84
Low Compliance - IM	1.97 - 2.31	1.08 - 1.1	0.98 - 1.51	2.09 - 2.22	2.09 - 2.81	1.29 - 2.82
Flexible fisher behaviour - IM	2.33 - 2.54	1.07 - 1.08	0.97 - 1.49	2.08 - 2.19	2.1 - 2.84	1.27 - 2.78
Increased fishing pressure drivers - IM	2.16 - 2.36	1.08 - 1.08	0.98 - 1.51	2.08 - 2.2	2.09 - 2.81	1.28 - 2.82
High Cost, Low Values - IM	2.91 - 3.49	1.07 - 1.07	0.96 - 1.47	2.06 - 2.17	2.12 - 2.85	1.25 - 2.73
Low Costs, High Values - IM	2.26 - 5.88	1.07 - 3.49	0.97 - 2.65	1.21 - 2.18	1.3 - 2.84	0.74 - 1.34
Standard Markets - IM	2.16 - 2.36	1.08 - 1.08	0.98 - 1.51	2.08 - 2.2	2.09 - 2.81	1.28 - 2.82
Technology Creep - IM	2.61 - 2.72	1.07 - 1.07	0.97 - 1.48	2.06 - 2.17	2.12 - 2.85	1.25 - 2.75
No Acclimation - 2010 coastal context - IM	1.52 - 2.24	1 - 1.65	0.78 - 1.32	1.02 - 1.55	0.96 - 1.28	0.39 - 135.56
No Acclimation - Cumulative impacts - SQ	0.49 - 1.21	0.96 - 5.68	0.84 - 2.43	1.63 - 2.78	0.75 - 1.26	0.11 - 173.55

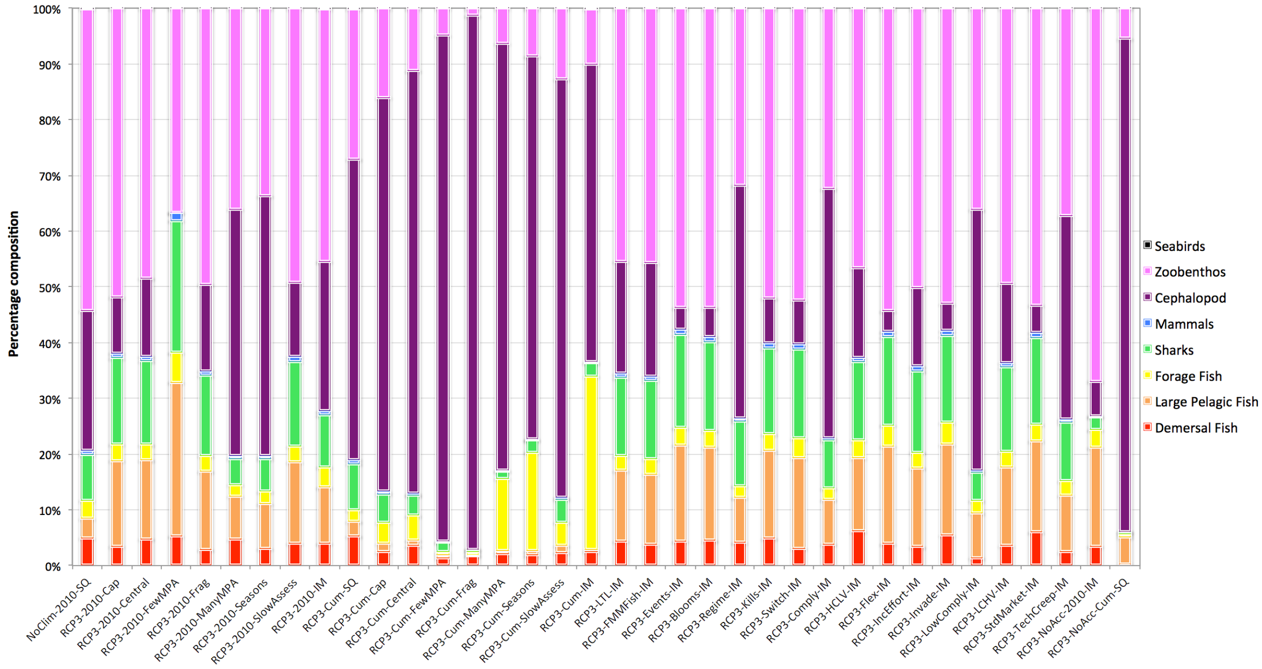


Figure 44: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 3

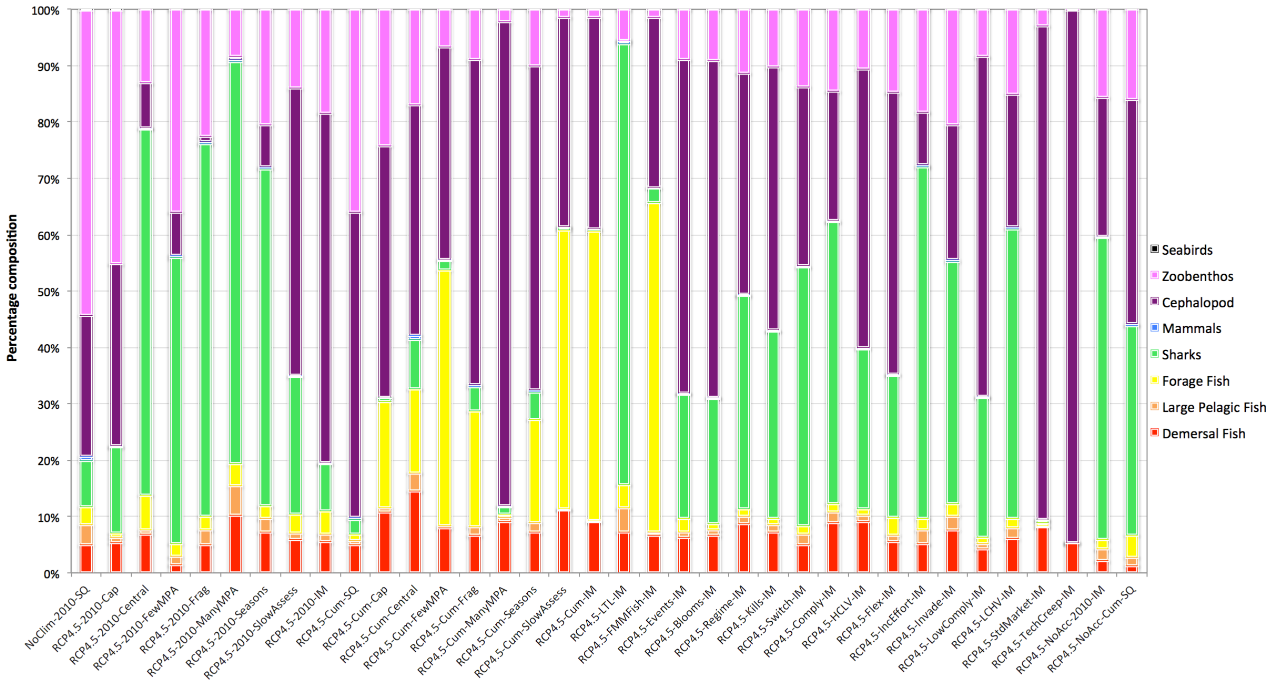


Figure 45: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 4.5

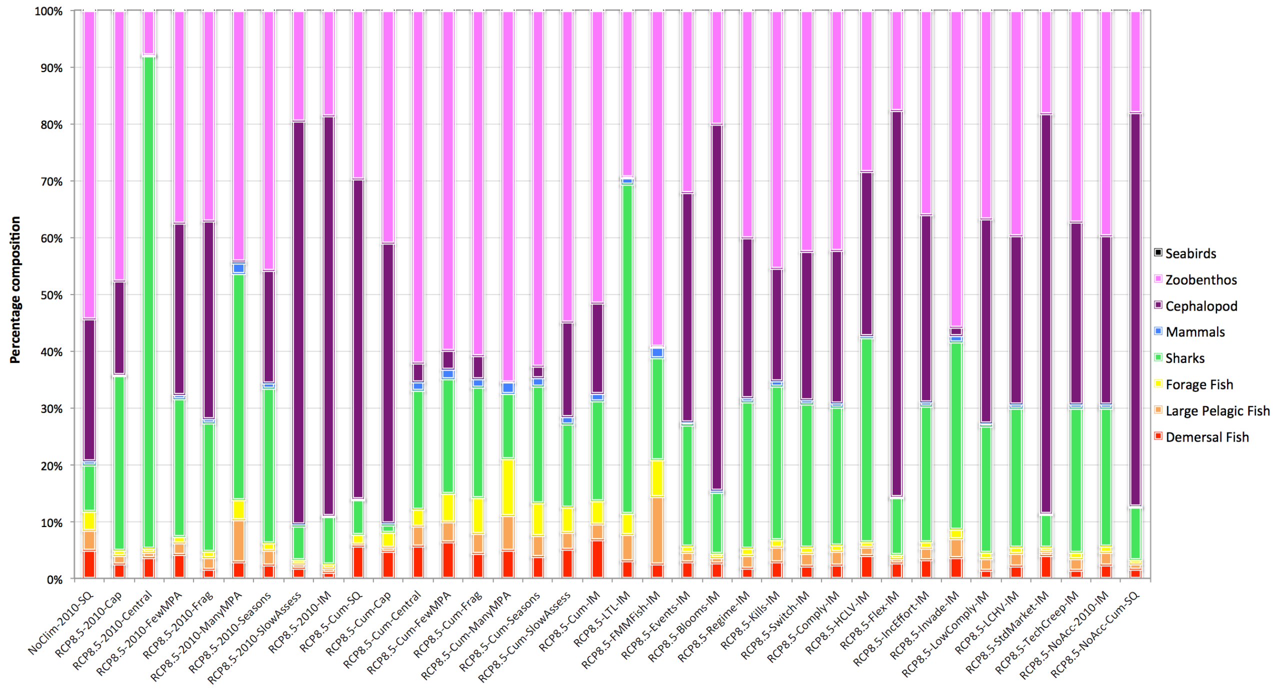


Figure 46: Average relative composition of biomass (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 8.5

The macrofaunal community composition of the inshore and shelf ecosystems of the southeast has always been more invertebrate and demersally dominated (even from the earliest recorded times according to diaries from the first fleet; Hill 2008), with chondrichthyans, crustacea and other zoobenthos taking on the roles filled by finfish in many northern temperate ecosystems. This pattern continues under most of the modelled emissions scenarios (Figures 44-46), with the contributions by chondrichthyans and cephalopods often increasing. Under RCP 3 the contribution to overall biomass by large pelagic fish does often expand – going from 5% to 15% or even 30% or more if there is little spatial management – except under cumulative impacts when cephalopods dominate the macrofaunal communities; the contribution by forage fish grows from <5% to nearly 40% in some instances, but the expansion of the cephalopod biomass contribution dominates (Figure 44). Relatively speaking demersal fish make up a larger proportion of the system's biomass under RCP 4.5 (Figure 45), but the cephalopods are still often a significant component of the community composition. The other major contributors are the chondrichthyans, or forage fish under cumulative impacts or when mesopelagics are fished. The composition under RCP 8.5 (Figure 46) is still skewed towards chondrichthyans and cephalopods, but less so than under the other emissions scenarios, with community compositions closer in many ways to that seen under the no climate change case. The cumulative impacts simulations again stand out to the other cases under RCP 8.5, but in this case because of the almost complete loss of cephalopods, with finfish and macrozoobenthos featuring more prominently.

The performance of the management strategies is not as clear-cut as for the offshore focused model. Nevertheless, the strategy that minimised spatial management had consistently poor performance and those strategies with extensive closures or integrated management performed well in terms of leading to healthy biomass levels for the majority of stocks. However, other strategies also met these criteria, particularly with the high productivity often seen under RCP 4.5. In that case status quo management was as robust as integrated management.

As with the offshore models there is little divergence in biomass trajectories between the emissions scenarios prior to 2030; although faster divergence is possible under some of the parameterisations. Abalone show the steepest decline, terminating in extirpation if there are cumulative impacts (Figure 47). However, the competitive interaction between flatheads and range extending shallow demersal fish can lead to some very nonlinear behaviour however (Figure 48). Variability within and between years grows for the primary producers (Figure 49) as emission levels increase, though this is dampened in the slower growing longer-lived groups (such as demersal sharks, Figure 50). As for Atlantis-SE, all trajectories will be posted to the **sea**view website, but trajectories for each group under integrated management are provided in Figures A.16 – A.30 as an illustrative example.

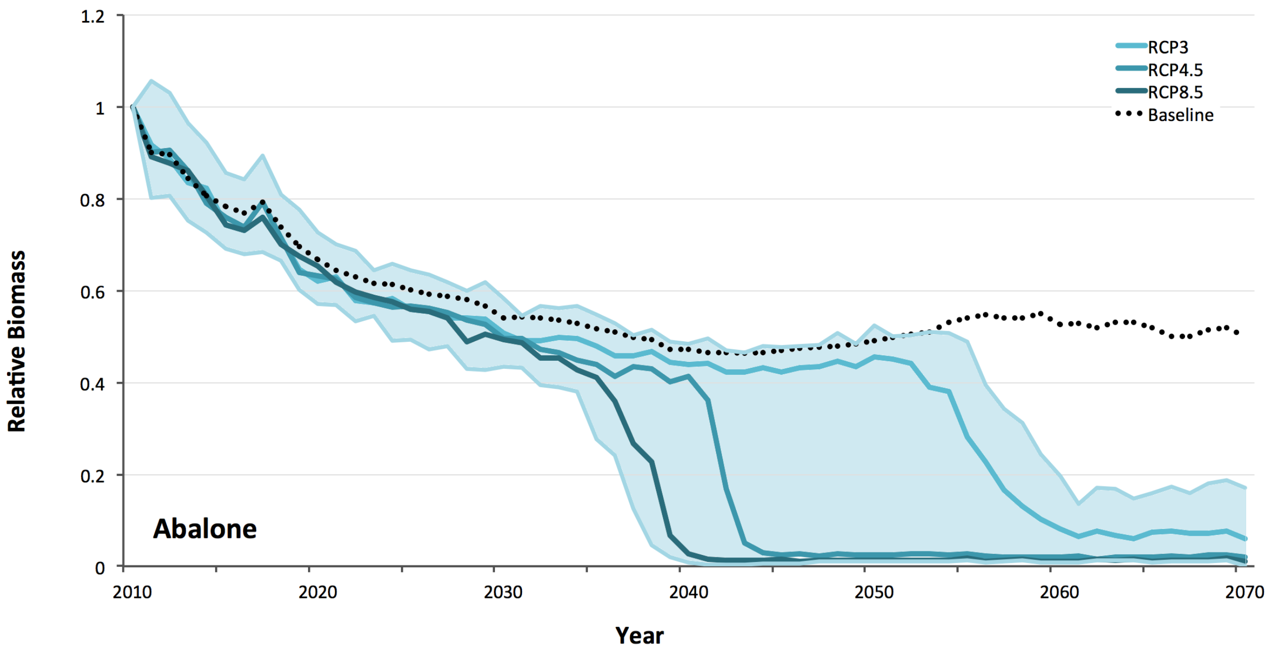


Figure 47: The average relative biomass of abalone through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

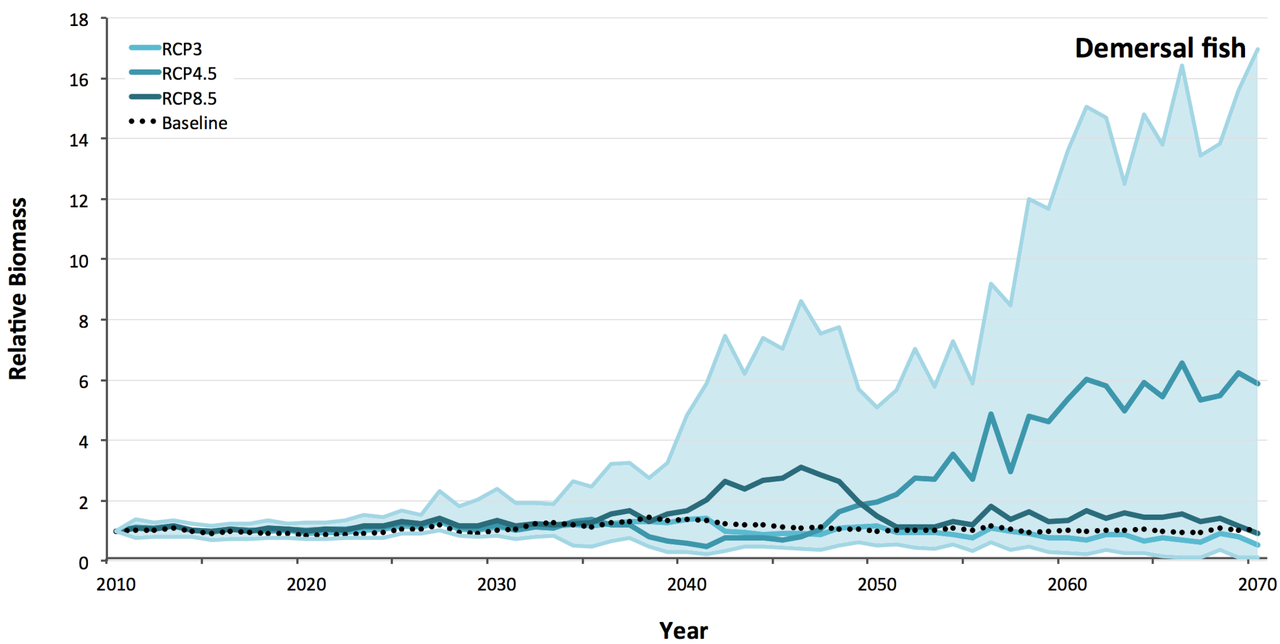


Figure 48: The average relative biomass of shallow demersal fish through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

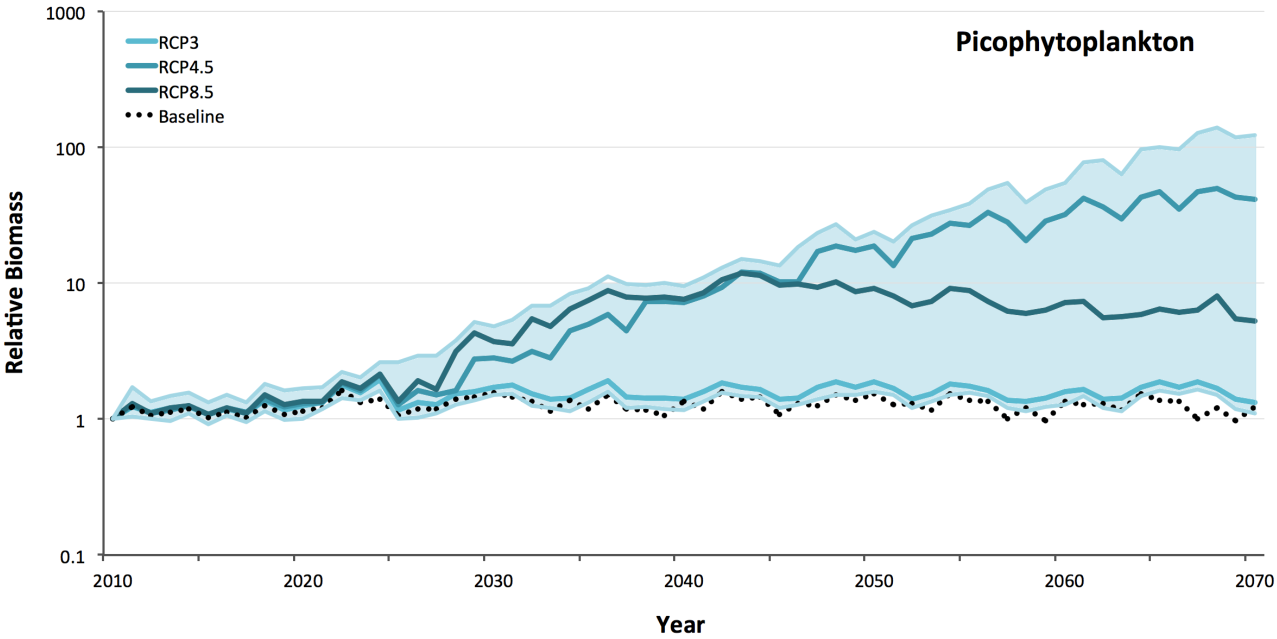


Figure 49: The average relative biomass of picophytoplankton group through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

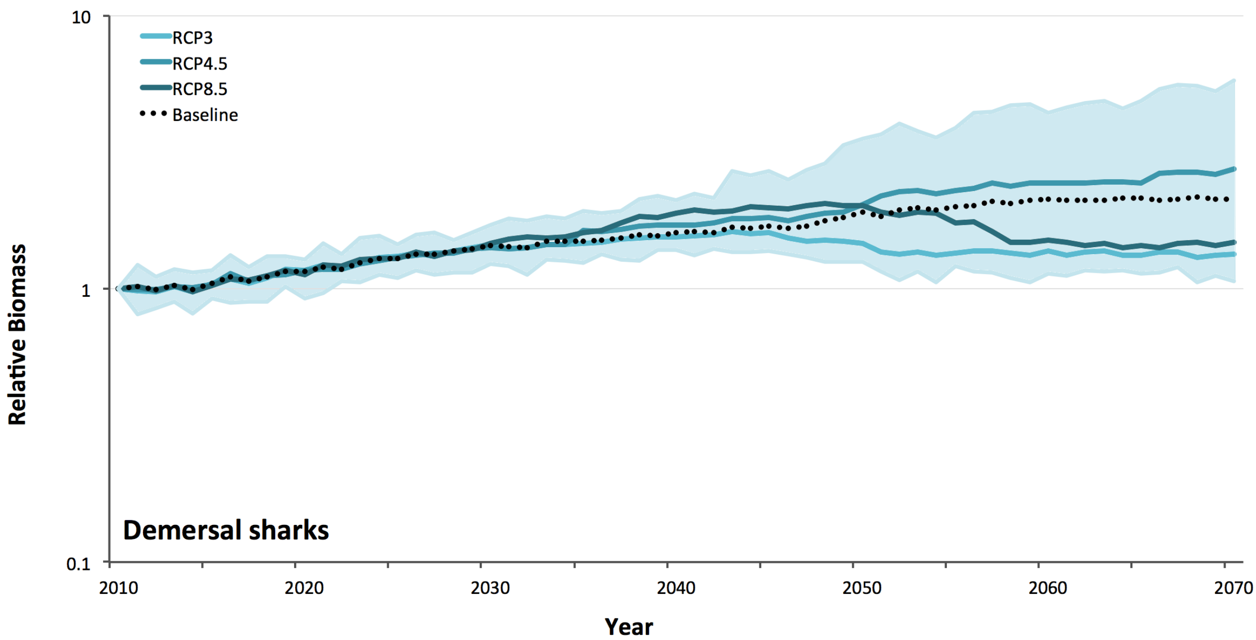


Figure 50: The average relative biomass of demersal sharks through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

The levels of acclimation and evolution expressed in this inshore model overlap with those seen in the more offshore focused Atlantis-SE, but tend to be truncated toward the higher range of values seen in that model. While the rates of change under RCP 3 are generally less than 0.1 SD per generation, the rates under RCP 4.5 are twice as high as for Atlantis-SE (with more groups expressing a rate of 0.15-0.2 SD) and cluster above 0.3 for many groups under RCP 8.5. The demersal fish rates reach 0.44 SD, which is at the upper end of any observed rates (Gingerich 2009). Before their extirpation abalone also briefly express rates of change > 0.35 SD, however their failure to survive indicates that even this was insufficient given the modelled stressors.

CONSERVATION STATUS

As with the offshore model the greatest number of vulnerable or exposed stocks was seen when there was no acclimation, although the levels were not quite as high (falling just short of 70% rather than exceeding 80%). When acclimation is included in the model the potential number of exposed stocks is lower, but it is also quite variable across parameterisations (Figures 51-53); more so than was the case for Atlantis-SE. Under RCP 3 the majority of strategies and scenarios have at least 30% of groups rated as vulnerable, however it is rare for a scenario or strategy to lead to more than 55% of groups to be rated as vulnerable or exposed. Parameterisations have an even stronger influence on RCP 4.5 simulations with the proportion of groups rated as vulnerable or exposed ranging from approximately 15% through to 55-60% for most strategies. The variability was again much lower under RCP 8.5, where the affect of cumulative impacts was also very clear. While there was significant variation across management strategies, approximately 25-40% could be rated as vulnerable or exposed if the cumulative impacts of all human activities in the oceans were not considered, this rose to 35-55% in most cases when there were cumulative impacts (Figure 53).

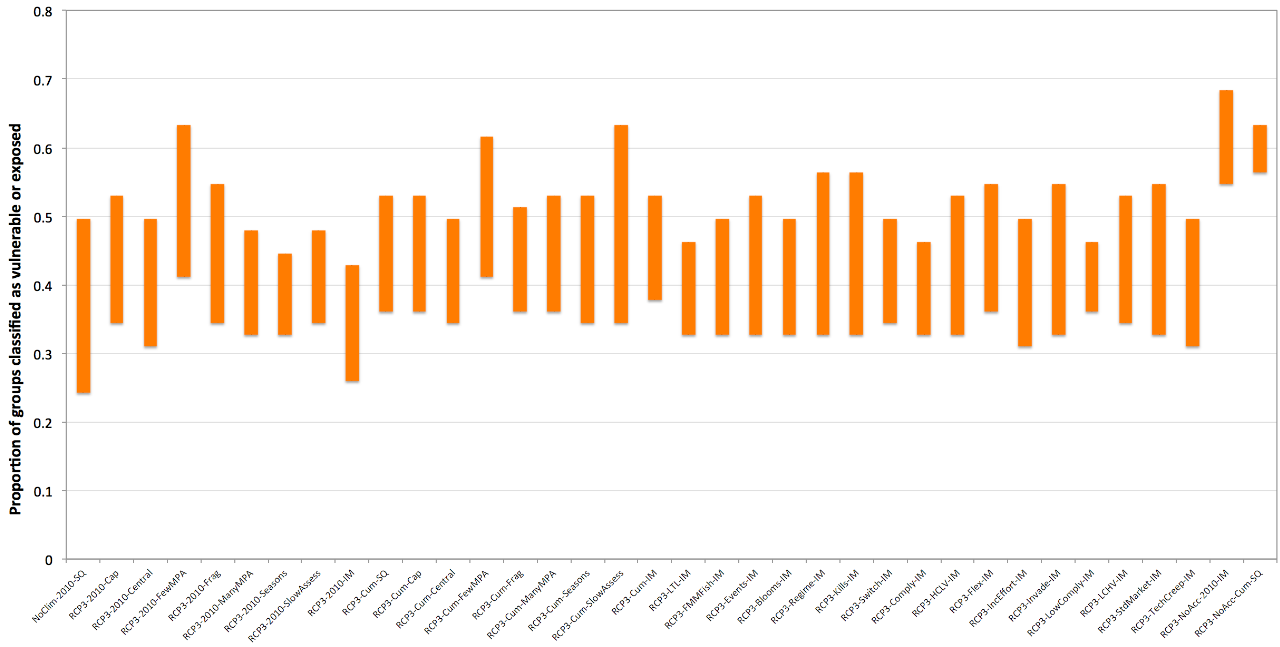


Figure 51: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SEAP under RCP 3

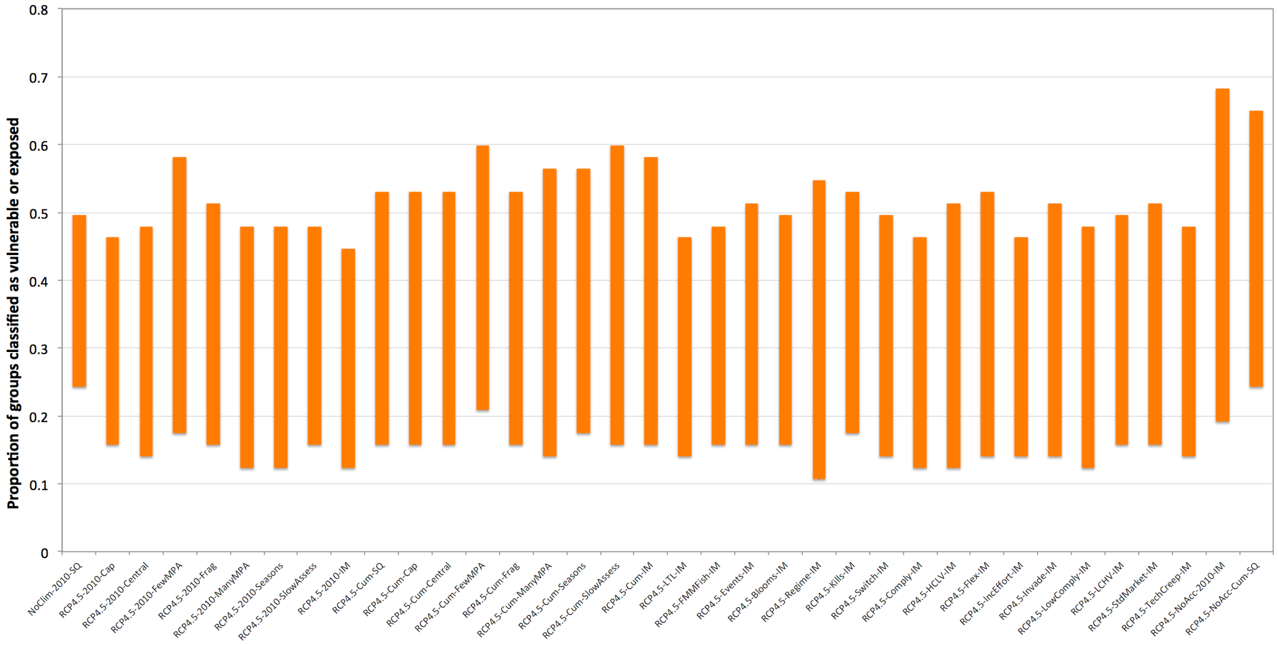


Figure 52: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SEAP under RCP 4.5

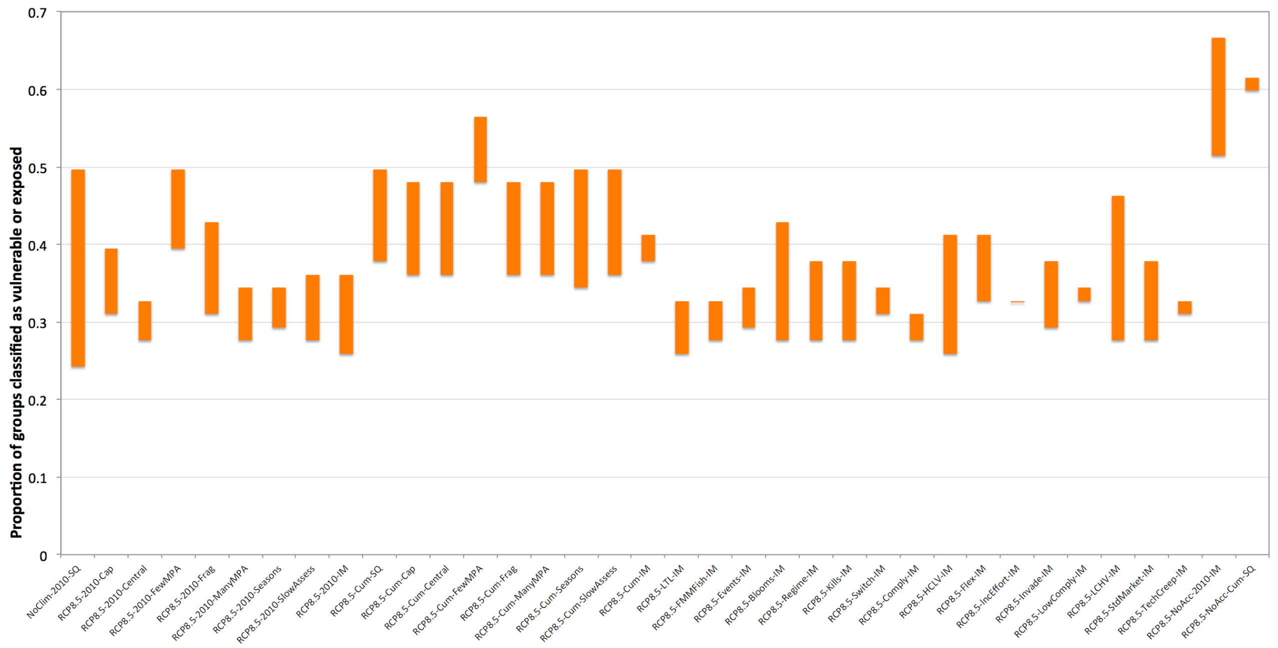


Figure 53: Range of proportion of the groups classified as vulnerable or exposed in 2065-2070 in Atlantis SEAP under RCP 8.5

Changes in biodiversity in Atlantis-SEAP were not as potentially strong as for Atlantis-SEAP (Figures 54-56). When there were cumulative impacts or an omission of acclimation there was (consistently) a small decrease in biodiversity of 5-25%, with potential drops strongest under RCP 4.5. Small increases in biomass (<10%) were possible under all emission scenarios, though more common under RCP 3. As was the case with Atlantis-SE the potential losses in biomass under RCP 8.5 are not as great as for the lower emission scenarios, driven more by the evenness seen under RCP 8.5 rather than richness.

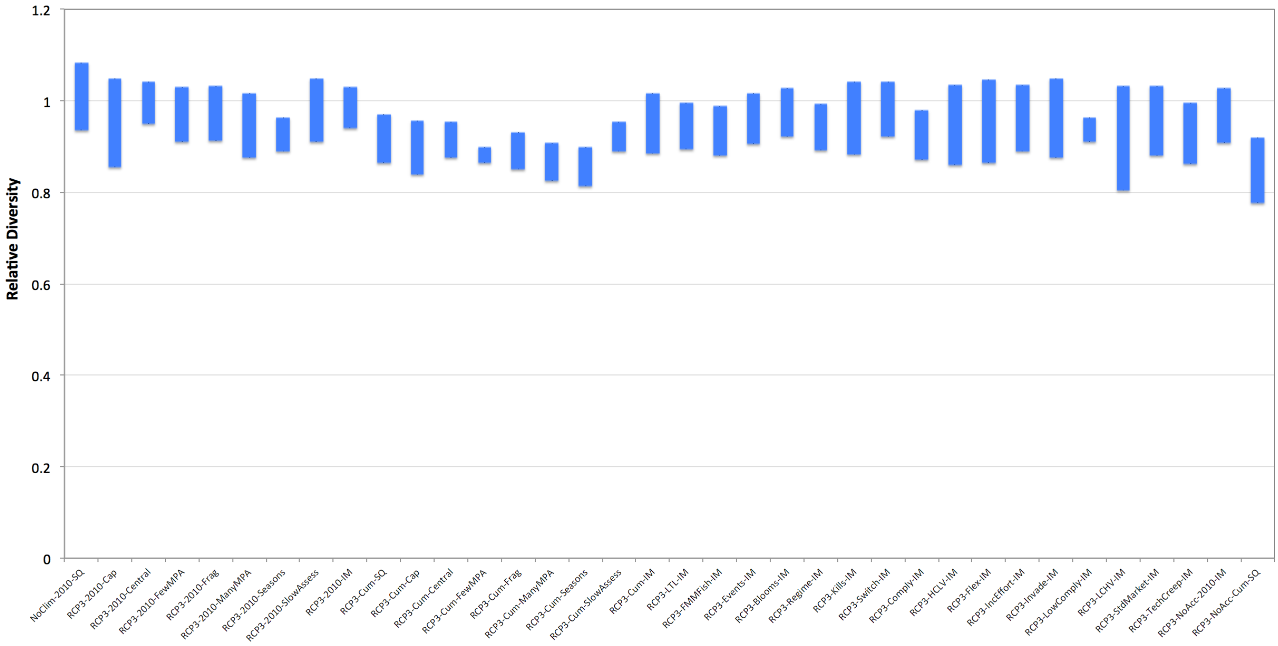


Figure 54: Range of relative marine biodiversity in 2065-2070 in Atlantis SEAP under RCP 3

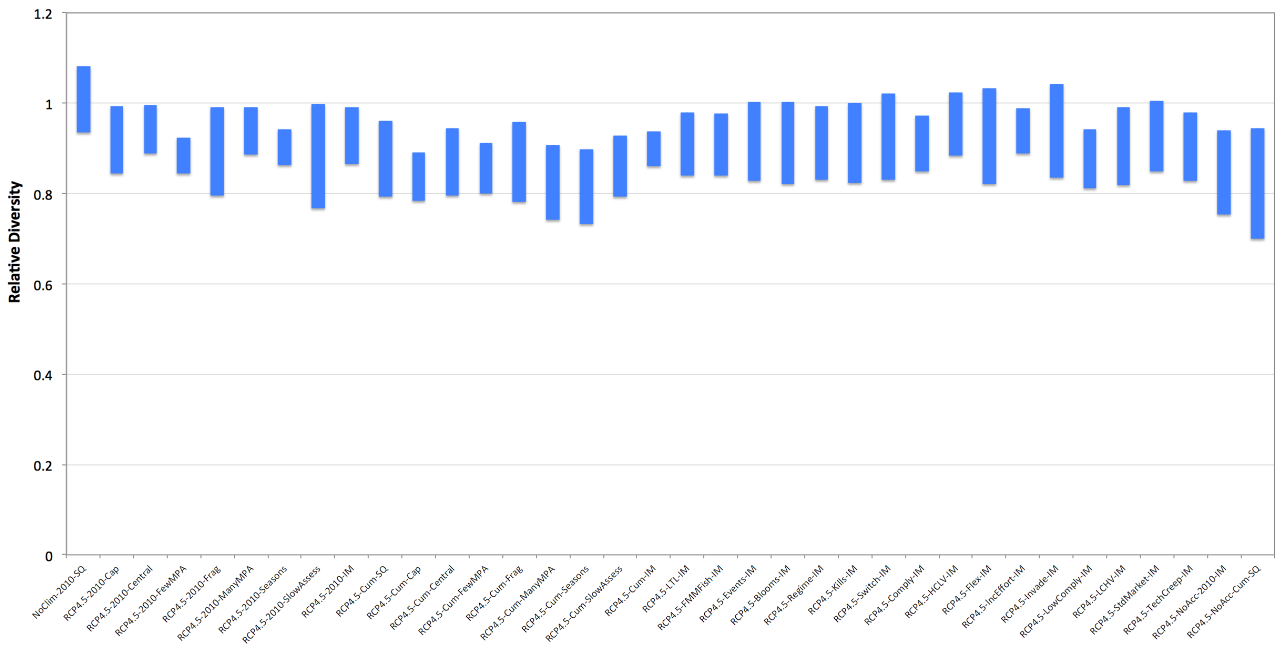


Figure 55: Range of relative marine biodiversity in 2065-2070 in Atlantis SEAP under RCP 4.5

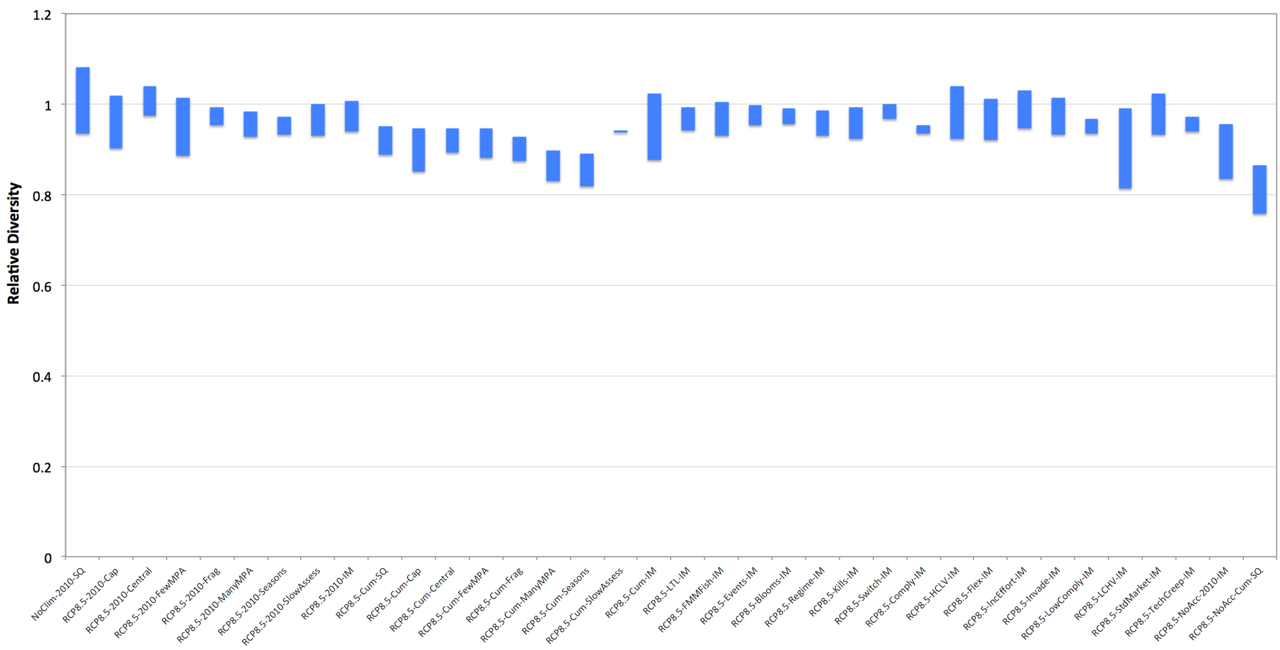


Figure 56: Range of relative marine biodiversity in 2065-2070 in Atlantis SEAP under RCP 8.5

In terms of the relative performance of the different management strategies, integrated management was clearly most effective under RCP 3 (both for biodiversity and the proportion of groups rated as vulnerable or exposed), but was not as clearly differentiated under the other emissions scenarios. Minimisation of spatial management performed poorly in all instances in terms of the proportion of exposed or vulnerable groups, although was not as clearly different in terms of biodiversity.

SYSTEM INDICATORS

The high uncertainty associated with the individual relative biomasses in Atlantis-SE also makes any statements on the final structural state of the system uncertain too. On average, under all emission scenarios the system biomass becomes more pelagic through time, but simultaneously more piscivorous (Tables 29-31). The former is typical of systems under stress; the later confuses the situation but is driven in the main by range shifting finfish. It also misses the overwhelming signature that cephalopods can leave in the system, whereas the expansion of mesopelagics in Atlantis-SE was effectively captured by these classical applied biomass ratios. Moreover, the shifts in production see in Atlantis-SE are not as strongly felt in Atlantis-SEAP as many groups can access the macrophytes, which buffer this more inshore system from any shocks in the planktonic production. Nevertheless it is possible (depending on the parameterisation) for these biomass ratios to show declines. The piscivore:planktivore biomass ratio drops below one for many of the cumulative impacts scenarios under RCP3 and lower productivity parameterisations. The same parameterisation under RCP 4.5 sees this biomass ratio almost universally less than 1, although it is again >1 under RCP 8.5 regardless of management strategy.

The performance of the pelagic:demersal ratio under the low productivity parameterisation indicates that this index may be difficult to interpret in some situations (something previously thought only to occur when applied at inappropriate spatial scales, Smith et al 2011b). With this low productivity parameterisation, pelagic:demersal biomass has an increasing number of instances where it is <1 as emissions increase. Under RCP 3 it is only noticeably < 1 when there are cumulative impacts and status quo or little spatial management. Under RCP 4.5 the instances <1 expand to include all cases where there are cumulative impacts. Under RCP 8.5 pelagic:demersal biomass is <1 under many of the cumulative impacts cases but also when some of the management strategies judged robust by other criteria (e.g. stock status or biodiversity) are in place. This mix of results is because it is not management alone leading to relative increases (and decreases) or the constituent fish groups. Moreover, as a proportion of total stock biomass these fish groups may only make up only a small percentage in some cases and so the index is not capturing the ecosystem-level shifts dominated by the cephalopods and chondrichthyans.

Mean potential longevity (MPL) and the large fish index (LFI) perhaps do a better job of capturing system restructuring (Tables 29-31), although they can also be difficult to interpret if environmental and management drivers act in opposition (or orthogonally). MPL consistently declines by 15% or more under cumulative impacts (across all emission scenarios) and almost universally under RCP 4.5. The LFI shows very similar patterns – declining under cumulative impacts and across the board under RCP 4.5. Low compliance, increased fishing pressure and slow assessment cycles tend to exacerbate declines in MPL across emission scenarios, whereas the bolstering of stocks of smaller bodied reef fish (e.g. herring cale, syngnathids) and

Table 29: Mean system indicators (± s.e.) for Atlantis SEAP (in 2065-2070) under the RCP 3 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	1.02 (± 0.08)	4.12 (± 5.2)	7.46 (± 5.93)	0.74 (± 0.16)	20.58 (± 2.73)
2010 coastal context - Cap ecosystem take	0.97 (± 0.1)	5.44 (± 5.4)	20.16 (± 5.81)	0.94 (± 0.07)	37.76 (± 15.71)
2010 coastal context - Centralised mgmt.	1.01 (± 0.05)	3.07 (± 2.59)	21.92 (± 6.86)	0.93 (± 0.1)	37.59 (± 15.88)
2010 coastal context - FewMPA	0.99 (± 0.07)	9.7 (± 7.86)	15.14 (± 4.17)	0.95 (± 0.08)	45.14 (± 12.5)
2010 coastal context - Fragmented mgmt	0.96 (± 0.07)	4.64 (± 2.03)	21.35 (± 7.98)	0.95 (± 0.07)	38.32 (± 15.34)
2010 coastal context - ManyMPA	0.96 (± 0.07)	2.71 (± 2.66)	10.45 (± 2.06)	0.83 (± 0.16)	29.13 (± 19.88)
2010 coastal context - Seasons	0.94 (± 0.04)	2.93 (± 2.52)	9.07 (± 6.1)	0.82 (± 0.11)	25.85 (± 12.32)
2010 coastal context - SlowAssess	0.96 (± 0.08)	2.08 (± 0.99)	7.64 (± 5.52)	0.78 (± 0.06)	21.23 (± 11.55)
2010 coastal context - Integrated Mgmt (IM)	0.98 (± 0.05)	4.77 (± 3.58)	2.83 (± 3.89)	0.44 (± 0.34)	16.64 (± 5.1)
Cumulative impacts - 2010 Status Quo (SQ)	0.9 (± 0.06)	3.48 (± 2.76)	6.58 (± 4.79)	0.65 (± 0.24)	19.65 (± 3.38)
Cumulative impacts - Cap ecosystem take	0.88 (± 0.06)	31.61 (± 46.7)	2.72 (± 2.45)	0.46 (± 0.4)	15.67 (± 4.43)
Cumulative impacts - Centralised mgmt.	0.9 (± 0.04)	4.98 (± 3.71)	2.19 (± 1.68)	0.48 (± 0.3)	16.56 (± 1.53)
Cumulative impacts - FewMPA	0.88 (± 0.02)	6.94 (± 10.81)	6.65 (± 4.24)	0.63 (± 0.07)	25.94 (± 1.26)
Cumulative impacts - Fragmented mgmt	0.88 (± 0.04)	5.98 (± 5.06)	2.22 (± 1.95)	0.51 (± 0.3)	17.15 (± 1.47)
Cumulative impacts - ManyMPA	0.87 (± 0.04)	15.97 (± 18.85)	1.58 (± 2.34)	0.32 (± 0.44)	12.03 (± 1.53)
Cumulative impacts - Seasons	0.85 (± 0.04)	27.98 (± 37.84)	1.87 (± 2.89)	0.34 (± 0.45)	11.69 (± 1.28)
Cumulative impacts - SlowAssess	0.93 (± 0.04)	7.6 (± 6.41)	13.33 (± 9.38)	0.8 (± 0.32)	32.78 (± 19.71)
Cumulative impacts - IM	0.94 (± 0.07)	34.13 (± 46.56)	1.79 (± 2.86)	0.35 (± 0.49)	17.36 (± 9.79)
Expanded LTL fishery - IM	0.96 (± 0.05)	4 (± 4)	15.73 (± 6.8)	0.9 (± 0.09)	35.55 (± 15.04)
New mesopelgic fishery - IM	0.95 (± 0.06)	3.07 (± 1.88)	17.35 (± 4.66)	0.92 (± 0.09)	35.83 (± 16.9)
Extreme climate events - IM	0.97 (± 0.06)	3.92 (± 2.47)	23.5 (± 8.16)	0.94 (± 0.09)	37.23 (± 16.6)
Blooms - IM	0.96 (± 0.06)	4.23 (± 2.31)	22.75 (± 7.7)	0.94 (± 0.1)	37.62 (± 16.05)
Primary production regime shift - IM	0.96 (± 0.06)	4.03 (± 3.19)	23.05 (± 8.44)	0.91 (± 0.14)	36.67 (± 17.14)
Fish kills - IM	0.97 (± 0.08)	4.5 (± 3.41)	23.17 (± 8.51)	0.93 (± 0.11)	37.85 (± 16.14)
Range extensions - IM	0.98 (± 0.06)	4.13 (± 1.75)	28.26 (± 17.98)	0.95 (± 0.07)	39.05 (± 14.53)
Gear switching allowed - IM	0.94 (± 0.06)	2.86 (± 2.53)	13.15 (± 4.65)	0.87 (± 0.13)	35.57 (± 14.22)
High compliance - IM	0.97 (± 0.1)	4.48 (± 5.37)	23.56 (± 9.2)	0.91 (± 0.14)	36.92 (± 16.96)
Low Compliance - IM	0.96 (± 0.09)	4.95 (± 3.17)	18.64 (± 6.22)	0.95 (± 0.08)	38.29 (± 14.46)
Flexible fisher behaviour - IM	0.98 (± 0.08)	3 (± 1.98)	20.63 (± 6.63)	0.94 (± 0.06)	37.44 (± 15.83)
Increased fishing pressure drivers - IM	0.98 (± 0.09)	4.23 (± 3.56)	22.48 (± 10.27)	0.92 (± 0.12)	37.03 (± 16.83)
High Cost, Low Values - IM	0.93 (± 0.03)	3.95 (± 1.87)	6.47 (± 4.73)	0.81 (± 0.16)	22.93 (± 5.94)
Low Costs, High Values - IM	0.94 (± 0.12)	11.76 (± 16.14)	17.91 (± 6.26)	0.93 (± 0.08)	37.72 (± 14.94)
Standard Markets - IM	0.98 (± 0.08)	4.03 (± 3.69)	24 (± 8)	0.92 (± 0.12)	37.06 (± 16.81)
Technology Creep - IM	0.94 (± 0.07)	3.99 (± 1.98)	11.4 (± 2.09)	0.91 (± 0.06)	36.07 (± 14.65)
No Acclimation - 2010 coastal context - IM	0.96 (± 0.06)	3.6 (± 1.37)	22.2 (± 13.24)	0.94 (± 0.08)	35.31 (± 16.82)
No Acclimation - Cumulative impacts - SQ	0.83 (± 0.08)	32.12 (± 40.4)	45.32 (± 58.48)	0.96 (± 0.04)	39.12 (± 14.52)

Table 30: Mean system indicators (± s.e.) for Atlantis SEAP (in 2065-2070) under the RCP 4.5 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	1.02 (± 0.08)	4.12 (± 5.2)	7.46 (± 5.93)	0.74 (± 0.16)	20.58 (± 2.73)
2010 coastal context - Cap ecosystem take	0.9 (± 0.08)	98.87 (± 164.34)	17.86 (± 15.59)	0.75 (± 0.32)	28.66 (± 3.39)
2010 coastal context - Centralised mgmt.	0.94 (± 0.05)	57.11 (± 92.85)	17.54 (± 14.82)	0.73 (± 0.32)	28.3 (± 3.93)
2010 coastal context - FewMPA	0.87 (± 0.04)	32.03 (± 38.01)	14.33 (± 10.18)	0.87 (± 0.12)	41.37 (± 12.93)
2010 coastal context - Fragmented mgmt	0.91 (± 0.1)	59 (± 94.52)	16.94 (± 14.73)	0.75 (± 0.33)	28.5 (± 3.11)
2010 coastal context - ManyMPA	0.92 (± 0.06)	41.95 (± 67.26)	12.8 (± 13.51)	0.63 (± 0.35)	18.53 (± 5.91)
2010 coastal context - Seasons	0.9 (± 0.04)	43.77 (± 69.72)	12.59 (± 11.37)	0.62 (± 0.46)	17.43 (± 4.92)
2010 coastal context - SlowAssess	0.89 (± 0.12)	159.45 (± 263.91)	9.13 (± 12.12)	0.56 (± 0.48)	14.6 (± 9.36)
2010 coastal context - Integrated Mgmt (IM)	0.93 (± 0.06)	10.45 (± 15.38)	8.7 (± 12.67)	0.58 (± 0.34)	17 (± 6.09)
Cumulative impacts - 2010 Status Quo (SQ)	0.88 (± 0.08)	5.35 (± 7.07)	12.61 (± 11.74)	0.71 (± 0.21)	20.56 (± 5.98)
Cumulative impacts - Cap ecosystem take	0.85 (± 0.06)	15.98 (± 14.36)	7.51 (± 8.89)	0.51 (± 0.36)	16.08 (± 1.91)
Cumulative impacts - Centralised mgmt.	0.88 (± 0.08)	7.8 (± 11.18)	6.92 (± 7.5)	0.58 (± 0.22)	18.23 (± 2.68)
Cumulative impacts - FewMPA	0.85 (± 0.06)	20.72 (± 34.65)	12.6 (± 10.06)	0.64 (± 0.12)	25.65 (± 5.08)
Cumulative impacts - Fragmented mgmt	0.88 (± 0.09)	7.91 (± 11.39)	6.02 (± 5.26)	0.62 (± 0.2)	18.98 (± 3.22)
Cumulative impacts - ManyMPA	0.84 (± 0.08)	10.19 (± 8.54)	2.9 (± 2.41)	0.4 (± 0.4)	12.76 (± 1.35)
Cumulative impacts - Seasons	0.83 (± 0.08)	14.03 (± 12.24)	3.02 (± 2.63)	0.43 (± 0.41)	12.54 (± 2.02)
Cumulative impacts - SlowAssess	0.87 (± 0.07)	9.97 (± 8.43)	20.76 (± 4.03)	0.82 (± 0.29)	34.07 (± 19.78)
Cumulative impacts - IM	0.89 (± 0.04)	21.08 (± 17.61)	2.49 (± 2.4)	0.46 (± 0.41)	19.6 (± 8.91)
Expanded LTL fishery - IM	0.92 (± 0.07)	54.79 (± 88.97)	17.83 (± 15.17)	0.7 (± 0.35)	26.48 (± 3.15)
New mesopelgic fishery - IM	0.91 (± 0.07)	54.62 (± 88.17)	14.23 (± 12.23)	0.7 (± 0.34)	25.63 (± 1.42)
Extreme climate events - IM	0.92 (± 0.09)	58.55 (± 94.77)	18.14 (± 15.57)	0.75 (± 0.3)	28.09 (± 2.58)
Blooms - IM	0.92 (± 0.09)	58.02 (± 93.83)	17.74 (± 15.13)	0.73 (± 0.32)	28 (± 3.12)
Primary production regime shift - IM	0.91 (± 0.08)	59.51 (± 97.55)	19.7 (± 16.45)	0.72 (± 0.29)	27.96 (± 4.64)
Fish kills - IM	0.91 (± 0.09)	61.78 (± 100.59)	17.68 (± 14.79)	0.75 (± 0.28)	29.27 (± 4.02)
Range extensions - IM	0.93 (± 0.1)	58.61 (± 93.02)	28.38 (± 32.14)	0.74 (± 0.34)	29.47 (± 6.21)
Gear switching allowed - IM	0.9 (± 0.06)	42.07 (± 67.3)	16.36 (± 14.07)	0.66 (± 0.36)	26.53 (± 5.47)
High compliance - IM	0.94 (± 0.08)	63.42 (± 104.41)	19.34 (± 16.09)	0.74 (± 0.25)	29.4 (± 4.76)
Low Compliance - IM	0.92 (± 0.11)	64.39 (± 103.6)	16.6 (± 14.32)	0.73 (± 0.34)	28.36 (± 5.06)
Flexible fisher behaviour - IM	0.93 (± 0.05)	54.72 (± 87.83)	16.83 (± 14.53)	0.74 (± 0.34)	27.79 (± 3.28)
Increased fishing pressure drivers - IM	0.93 (± 0.1)	61.79 (± 100.92)	18.01 (± 15.21)	0.74 (± 0.28)	28.66 (± 3.56)
High Cost, Low Values - IM	0.89 (± 0.07)	48.21 (± 75.55)	9.83 (± 9.16)	0.63 (± 0.5)	17.68 (± 6.09)
Low Costs, High Values - IM	0.88 (± 0.1)	283.7 (± 484.83)	18.55 (± 16.38)	0.72 (± 0.35)	28.06 (± 4.77)
Standard Markets - IM	0.93 (± 0.08)	61.61 (± 100.8)	18.6 (± 15.58)	0.74 (± 0.28)	28.6 (± 3.66)
Technology Creep - IM	0.9 (± 0.08)	48.07 (± 75.92)	12.77 (± 10.91)	0.71 (± 0.37)	26.72 (± 4.12)
No Acclimation - 2010 coastal context - IM	0.86 (± 0.1)	31.27 (± 45.47)	21.7 (± 22.98)	0.74 (± 0.34)	27.37 (± 3.46)
No Acclimation - Cumulative impacts - SQ	0.8 (± 0.13)	169.66 (± 292.87)	61.39 (± 91.17)	0.66 (± 0.56)	26.31 (± 15.93)

Table 31: Mean system indicators (± s.e.) for Atlantis SEAP (in 2065-2070) under the RCP 8.5 emissions scenario

Scenario	Diversity	Pelagic:Demersal Biomass	Pisciv:Planktiv Biomass	Large fish index	Mean potential longevity
No Climate change - 2010 context - SQ	1.02 (± 0.08)	4.12 (± 5.2)	7.46 (± 5.93)	0.74 (± 0.16)	20.58 (± 2.73)
2010 coastal context - Cap ecosystem take	0.97 (± 0.06)	4.51 (± 4.81)	45.81 (± 24.85)	0.97 (± 0.04)	32.9 (± 16.88)
2010 coastal context - Centralised mgmt.	1.01 (± 0.03)	2.59 (± 2.53)	40.76 (± 17.46)	0.95 (± 0.05)	33.05 (± 16.92)
2010 coastal context - FewMPA	0.97 (± 0.07)	7.96 (± 8.45)	23.19 (± 10.96)	0.95 (± 0.07)	47.21 (± 13.42)
2010 coastal context - Fragmented mgmt	0.97 (± 0.02)	4.24 (± 1.42)	38.28 (± 17.85)	0.97 (± 0.04)	32.2 (± 17.6)
2010 coastal context - ManyMPA	0.97 (± 0.03)	1.26 (± 0.97)	26.51 (± 10.07)	0.89 (± 0.11)	25.82 (± 20.64)
2010 coastal context - Seasons	0.95 (± 0.02)	1.51 (± 0.97)	21.03 (± 8.68)	0.92 (± 0.04)	21.82 (± 11.59)
2010 coastal context - SlowAssess	0.96 (± 0.04)	1.46 (± 0.7)	13.42 (± 5.7)	0.85 (± 0.06)	13.28 (± 6.86)
2010 coastal context - Integrated Mgmt (IM)	0.98 (± 0.04)	1.24 (± 1.03)	10.23 (± 10.23)	0.64 (± 0.24)	15.1 (± 2.4)
Cumulative impacts - 2010 Status Quo (SQ)	0.91 (± 0.03)	1.09 (± 0.77)	21.31 (± 7.21)	0.83 (± 0.08)	14.83 (± 3.36)
Cumulative impacts - Cap ecosystem take	0.89 (± 0.05)	2.99 (± 2.43)	8.36 (± 6.32)	0.73 (± 0.14)	13.78 (± 1.62)
Cumulative impacts - Centralised mgmt.	0.92 (± 0.03)	1.29 (± 1.24)	9.63 (± 2.37)	0.73 (± 0.09)	14.17 (± 1.81)
Cumulative impacts - FewMPA	0.91 (± 0.03)	2.23 (± 2.97)	13.94 (± 10.87)	0.63 (± 0.06)	26.72 (± 2.13)
Cumulative impacts - Fragmented mgmt	0.9 (± 0.03)	1.92 (± 2.15)	9.52 (± 2.54)	0.76 (± 0.1)	14.45 (± 2.68)
Cumulative impacts - ManyMPA	0.86 (± 0.03)	1.73 (± 0.45)	3.58 (± 3.51)	0.5 (± 0.29)	10.62 (± 1.35)
Cumulative impacts - Seasons	0.85 (± 0.04)	2.63 (± 1.09)	4.08 (± 4.73)	0.54 (± 0.31)	10.07 (± 1.52)
Cumulative impacts - SlowAssess	0.94 (± 0)	5 (± 5.87)	30.25 (± 15.85)	0.89 (± 0.17)	31.24 (± 20.32)
Cumulative impacts - IM	0.94 (± 0.08)	3.05 (± 1.8)	3.57 (± 3.8)	0.62 (± 0.24)	21.09 (± 10.7)
Expanded LTL fishery - IM	0.97 (± 0.03)	2.21 (± 1.86)	37.22 (± 14.18)	0.95 (± 0.05)	32.02 (± 16.94)
New mesopelgic fishery - IM	0.96 (± 0.04)	2.28 (± 1.61)	33.55 (± 13.12)	0.95 (± 0.05)	30.87 (± 17.82)
Extreme climate events - IM	0.98 (± 0.02)	3.31 (± 2.53)	41.92 (± 19.49)	0.96 (± 0.05)	31.98 (± 18.43)
Blooms - IM	0.97 (± 0.02)	3.69 (± 1.6)	40.27 (± 18.77)	0.96 (± 0.06)	31.72 (± 18.12)
Primary production regime shift - IM	0.96 (± 0.03)	3.5 (± 3.41)	44.04 (± 12.89)	0.96 (± 0.06)	30.46 (± 19.91)
Fish kills - IM	0.97 (± 0.04)	4.21 (± 4.09)	40.18 (± 18.41)	0.96 (± 0.06)	32.81 (± 17.87)
Range extensions - IM	0.99 (± 0.02)	3.27 (± 1.7)	55.6 (± 40.31)	0.97 (± 0.04)	33.63 (± 16.3)
Gear switching allowed - IM	0.95 (± 0.01)	1.38 (± 0.9)	33.13 (± 10.53)	0.93 (± 0.08)	33.7 (± 15.51)
High compliance - IM	0.99 (± 0.06)	5.68 (± 8.29)	43.26 (± 18.76)	0.94 (± 0.08)	32.66 (± 17.89)
Low Compliance - IM	0.97 (± 0.05)	4.93 (± 4.5)	33.31 (± 13.69)	0.97 (± 0.04)	31.4 (± 16.31)
Flexible fisher behaviour - IM	0.99 (± 0.04)	2.43 (± 1.84)	41.29 (± 19.34)	0.96 (± 0.03)	32.97 (± 16.95)
Increased fishing pressure drivers - IM	0.99 (± 0.05)	3.97 (± 4.33)	40.91 (± 19.73)	0.95 (± 0.07)	32.42 (± 18.13)
High Cost, Low Values - IM	0.96 (± 0.02)	2.31 (± 1.19)	14.22 (± 6.41)	0.93 (± 0.03)	18.58 (± 5.86)
Low Costs, High Values - IM	0.93 (± 0.1)	7.42 (± 9.79)	57.31 (± 40.78)	0.96 (± 0.05)	32.96 (± 15.46)
Standard Markets - IM	0.98 (± 0.05)	3.83 (± 4.44)	41.67 (± 18.86)	0.95 (± 0.07)	32.45 (± 18.11)
Technology Creep - IM	0.96 (± 0.02)	2.32 (± 0.55)	29.68 (± 12.88)	0.96 (± 0.04)	33.42 (± 16.48)
No Acclimation - 2010 coastal context - IM	0.89 (± 0.06)	2.74 (± 0.43)	40.29 (± 32.13)	0.95 (± 0.06)	33.6 (± 15.96)
No Acclimation - Cumulative impacts - SQ	0.81 (± 0.05)	51.69 (± 76.47)	91.85 (± 137.47)	0.96 (± 0.03)	39.16 (± 14.61)

oceanic planktivores (such as flying fish and sauries) under integrated management or extensive closures can contribute to a decline in LFI.

LANDINGS

Landings of filter feeders increase in all simulations where acclimation is allowed for, whereas the commercial landings of classically targeted zoobenthos (e.g. lobster) and large pelagic fish, especially shallow piscivorous fish, tend to decline (Tables A.10-A.12). Landings of other traditional targets, like abalone, flathead, blue grenadier and demersal sharks also tend to decrease in most instances. In contrast, the catch of urchins increases, except under some instances when there is extreme climate change. Many of the other major increases in catch are amongst range expanding species (such as stripey tuna) or for groups targeted by new fisheries – such as kelp, jellies and krill.

When groups are aggregated by type of organism some clear patterns exist (Tables 32-34). The patterns of landings for forage fish are dictated by the parameterisation under RCP 3 and 4.5 (i.e. landings increase or decrease depending on whether low or high productivity parameterisations are used), except for when mesopelagics are fished. In contrast the forage fish fisheries expand under RCP 8.5. Landings of demersal fish, sharks and cephalopods are dictated primarily by parameterisation – though the landings of demersal sharks (driven by spikey dogfish) increase more often then they decrease. The landings of sharks and cephalopods expand the most when those groups dominate ecosystem biomass (though exploitation rates remain <0.1), but can drop away to zero for more vulnerable or low productivity parameterisations. Catches for cephalopods also drop away if the population collapses when poor conditions exceed their life history length. The only consistent pattern in terms of strategy or scenario is that landings of these groups are lowest if costs are high and values low.

Total landings tend to increase through time (Figure 57), although the increases are not so large if there are cumulative impacts – under these conditions total landings can actually fall under RCP 3 and 4.5 for some parameterisations. The influence of parameterisations can overwhelm patterns due to the performance of management strategies, but total landings are most often highest on average when there is a slow assessment cycle or extensive use of seasonal closures. If there is little use of spatial management landings can be high, at least until stocks are negatively impacted across the model domain. Landings can also be high when there is extensive spatial management so long as the parameterisation allows for high productivity and spill over (from closed areas to fishing grounds). Landings are often lowest under integrated management.

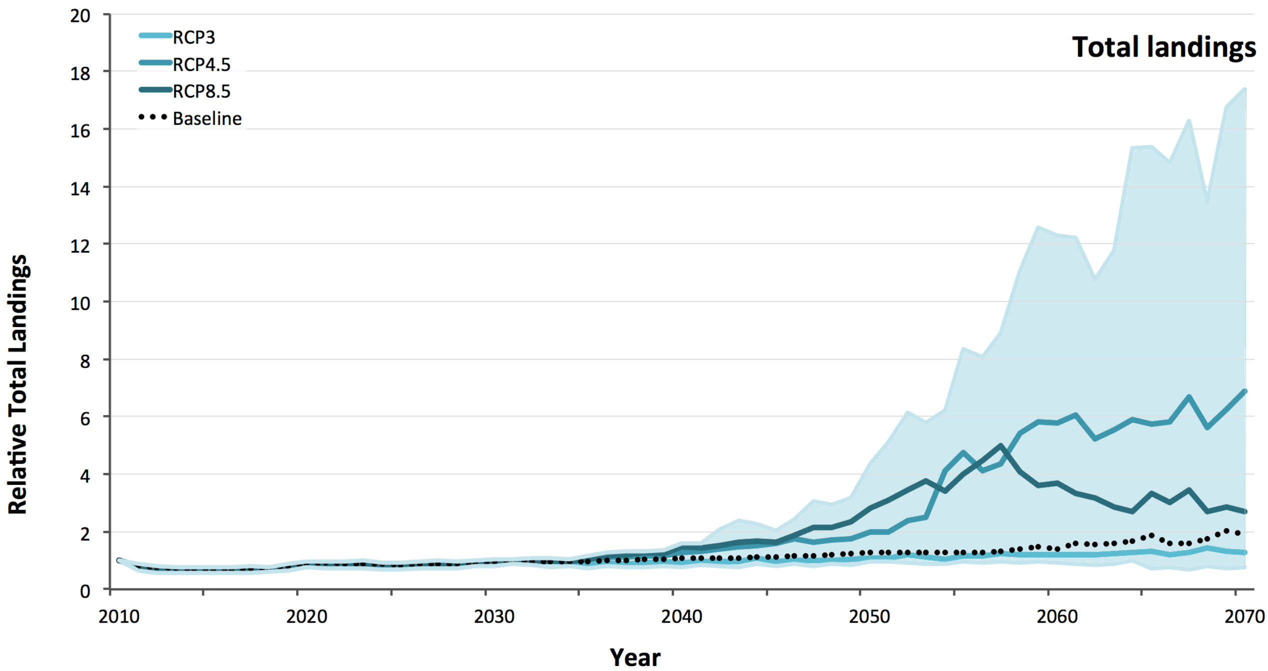


Figure 57: Average relative total landings through time from Atlantis-SEAP under each emission scenarios. The lighter shaded area is the total range.

The potentially extreme shifts in community structure are not typically fully represented in the catch composition (Figures 58-60), indicating some inertia in targeting. Nevertheless the average catch composition does shift in each case, though typically more in response to cumulative impacts and the emission scenarios than management strategies. Under RCP 3 the contribution by demersal fish drops while that by chondrichthyans increases substantially (Figure 58). There is also significant growth in contributions by cephalopod fisheries and other new invertebrate and kelp fisheries. All of these shifts are beyond that seen when there is no climate change. The main exception to this pattern is when the contribution by forage fish increases instead of the cephalopods or chondrichthyans, this occurs when there is an increase in fishing pressure or the initiation of a mesopelagic fishery. Under RCP 4.5 the contributions by both pelagic and demersal fish drops (Figure 59), replaced by cephalopods, chondrichthyans or by even larger increases in the contribution by the new fisheries (especially when there are cumulative impacts). The one exception is when there is a substantial increase in the contribution by forage fish when a mesopelagic fishery is exploited. Under RCP 8.5 the contributions by demersal fish and

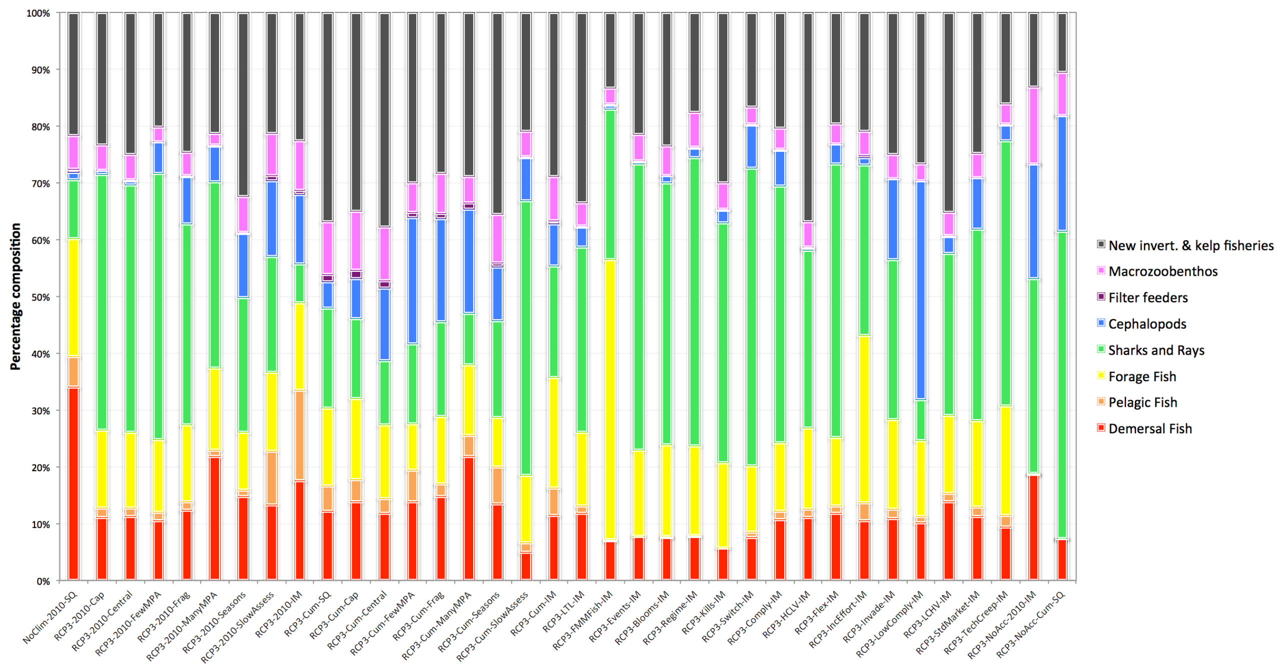


Figure 58: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 3

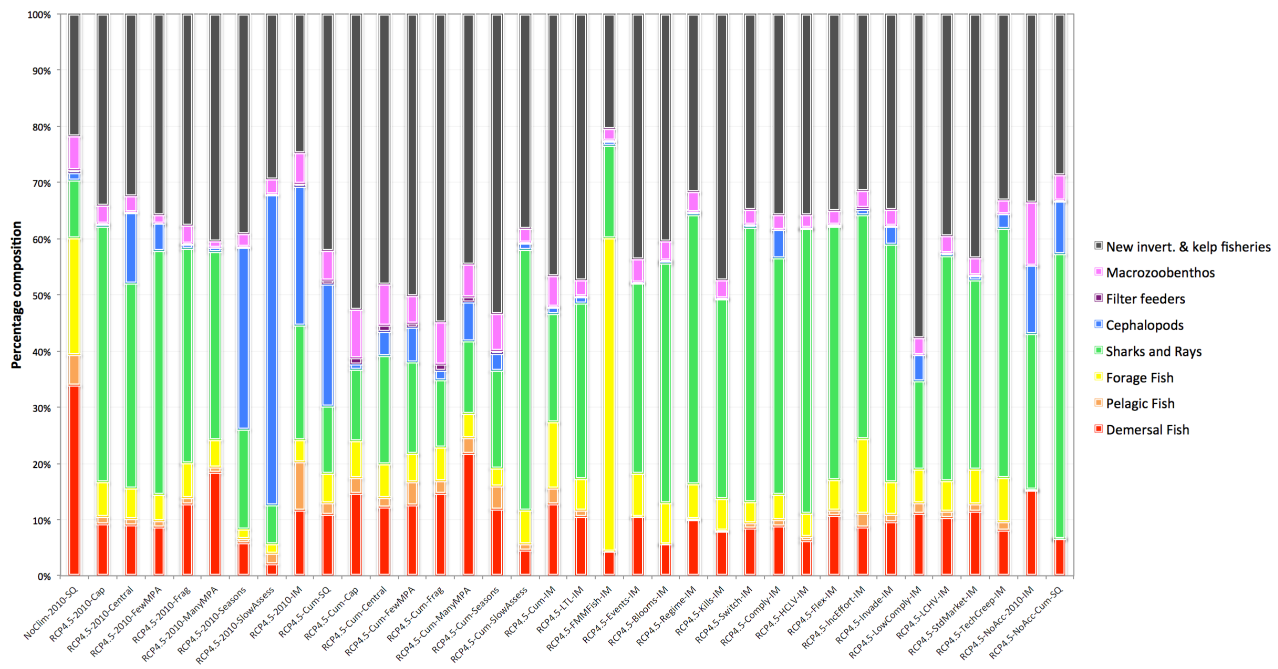


Figure 59: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 4.5

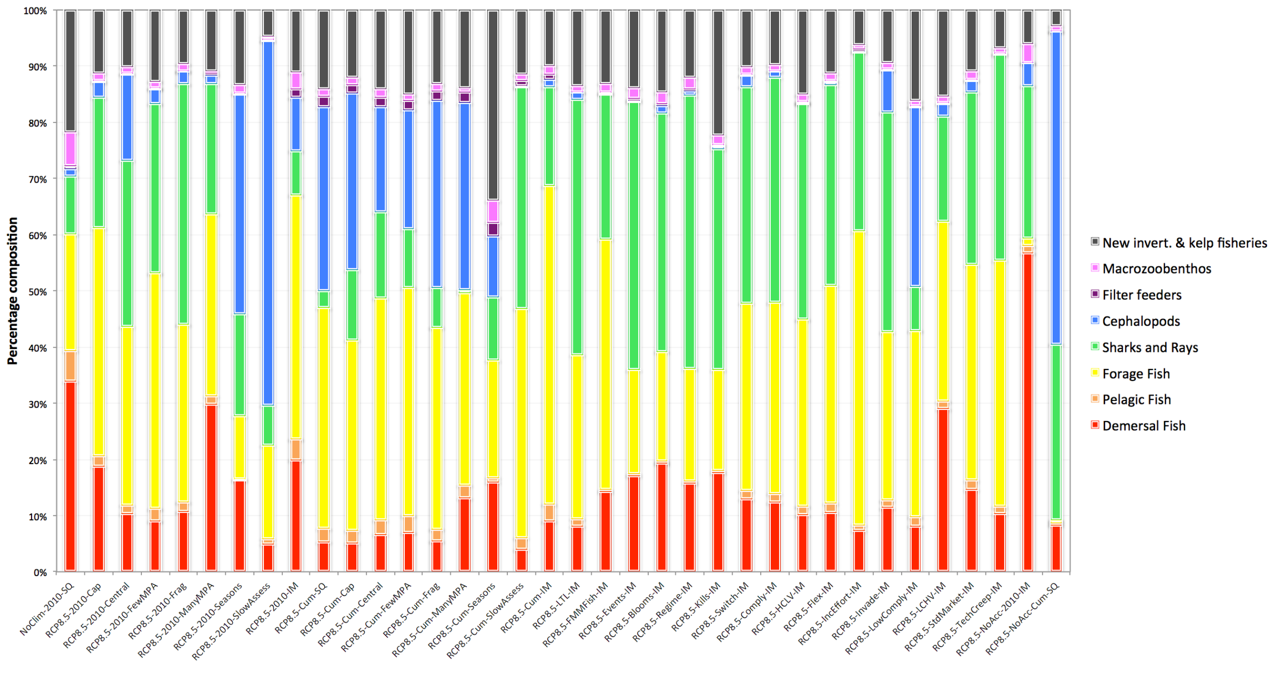


Figure 60: Average relative composition of landings (2065-2070) across scenarios and strategies in Atlantis SEAP under RCP 8.5

the new fisheries are roughly the same (at around 10-15% each), with approximately half of the remaining contribution (about 20-40%) from forage fish (Figure 60). The other portion is made up almost exclusively of either chondrichthyans or cephalopods. The major exception to this pattern is when there is no acclimation, in which case demersal fish make up roughly 57% of the landings, chondrichthyans 27% (with the remainder evenly spread across the other product classes) if there is integrated management; or is dominated by cephalopods (55.6%) and chondrichthyans (31.4%) under status quo management. The increase in the contribution of new fisheries and the continued targeting of aggregate functional groups despite the turn over in biodiversity (represented by the shifts in parameterisations) assumes that suitable markets can be found for these products.

Variability in landings in Atlantis-SEAP is most often influenced by productivity parameterisations. Under RCP 3, the greatest variability is when the system is under pressure form cumulative impacts, higher exploitation rates (whether through intensifying fishing pressure or when low costs favour fleet expansions) or when management is fragmented. Variability in landings is lower under RCP 4.5, except for when there are regime shifts or fish kills. Volatility under RCP 8.5 is larger than for RCP 4.5, particularly under cumulative impacts, extreme events, fish kills, blooms and regime shifts. This is because CPUE drives fisheries dynamics in this model, meaning it is often more sensitive to shorter term catch dynamics. This does not mean that human decision making doesn't influence the fisheries variability however, it does contribute to increased variability in the results under gear switching, differing levels of compliance, increased flexibility of responses, lower costs and when there technology creep.

EFFORT

There is a good deal of variation in response across fleets, with effort dropping for most fleets if there is extensive spatial management. Danish seine effort, pelagic longlining and gillnetting decrease in all instances. In contrast, demersal trawl only decreases under extensive spatial management under RCP 3 (Table 35). Under RCP 4.5 (Table 36) demersal trawl also increases under cumulative impacts and when fisher behaviour is more flexible, whereas under RCP 8.5 (Table 37) demersal trawl decreases by more than 40% in most instances. The other gear types tend to decrease across all RCP scenarios, except under RCP 8.5 when there is no acclimation, cumulative impacts or fishing pressure intensifies. In those cases effort

Table 32: Range of relative landings (in 2065-2070) by class of organism for Atlantis SEAP under the RCP 3 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
No Climate change - 2010 context - SQ	1.57 - 5.52	0.75 - 1.27	1.14 - 1.53	0.93 - 2.57	0.39 - 1.95	7.29 - 8.43	0.53 - 0.73	6.97 - 7.91	1.37 - 2.55
2010 coastal context - Cap ecosystem take	0.87 - 1.33	0.2 - 0.52	0.26 - 1.86	4.62 - 13.1	0.03 - 1.05	2.02 - 2.96	0.43 - 0.61	6.64 - 10.38	1.77 - 2.58
2010 coastal context - Centralised mgmt.	0.78 - 1.35	0.2 - 0.53	0.26 - 1.86	5.04 - 11.01	0.01 - 2.18	2.02 - 2.96	0.46 - 0.61	10.15 - 10.43	2.04 - 2.48
2010 coastal context - FewMPA	0.77 - 2.06	0.21 - 0.69	0.25 - 1.87	4.38 - 38.84	0.25 - 16.38	1.72 - 2.52	0.33 - 0.39	10.16 - 10.43	1.95 - 6.12
2010 coastal context - Fragmented mgmt	0.7 - 1.81	0.19 - 0.53	0.26 - 1.86	4.14 - 10.08	3.26 - 19.49	2.02 - 2.96	0.45 - 0.63	10.15 - 10.43	1.97 - 2.45
2010 coastal context - ManyMPA	1.07 - 5.09	0.18 - 0.57	0.25 - 1.79	0.49 - 54.97	1.72 - 18.08	2.1 - 3.18	0.3 - 0.31	10.18 - 10.45	1.52 - 8.42
2010 coastal context - Seasons	0.64 - 2.17	0.01 - 0.58	0.11 - 1.2	1.77 - 3.93	1.86 - 24.52	1.19 - 1.75	0.52 - 0.71	10.15 - 10.43	1.53 - 2.05
2010 coastal context - SlowAssess	0.5 - 1.37	0.19 - 4.15	0.06 - 1.86	2.15 - 2.74	2.72 - 19.2	2.15 - 18	0.47 - 0.77	2.92 - 10.15	1.18 - 1.78
2010 coastal context - Integrated Mgmt (IM)	0.8 - 1.34	0.22 - 3.17	0.06 - 1.86	0.36 - 1.5	1.05 - 21.81	2.14 - 13.8	0.47 - 0.66	4.46 - 7.09	0.93 - 1.48
Cumulative impacts - 2010 Status Quo (SQ)	0.13 - 1.09	0.25 - 0.63	0.06 - 1.02	0.84 - 1.64	0.24 - 3.48	8.81 - 12.87	0.36 - 0.5	6.09 - 6.26	0.75 - 1.03
Cumulative impacts - Cap ecosystem take	0.21 - 0.92	0.23 - 0.42	0.06 - 1.02	0.77 - 1.15	0.11 - 5.08	8.81 - 12.86	0.36 - 0.5	3.98 - 6.23	0.6 - 1.06
Cumulative impacts - Centralised mgmt.	0.17 - 0.95	0.17 - 0.34	0.06 - 1.02	0.59 - 1.07	0.27 - 14.42	8.81 - 12.88	0.36 - 0.5	6.09 - 6.26	0.68 - 1.18
Cumulative impacts - FewMPA	0.2 - 1.37	0.34 - 1.01	0.06 - 1.02	0.52 - 1.8	1.23 - 57.15	7.48 - 10.97	0.22 - 0.37	6.1 - 6.26	0.84 - 2.09
Cumulative impacts - Fragmented mgmt	0.18 - 1.44	0.17 - 0.36	0.06 - 1.02	0.45 - 3.98	0.24 - 17.83	8.8 - 12.87	0.36 - 0.5	6.09 - 6.26	0.9 - 1.48
Cumulative impacts - ManyMPA	0.27 - 2.67	0.29 - 0.83	0.06 - 0.98	0.16 - 2.37	0.22 - 22.78	9.16 - 13.84	0.16 - 0.4	6.11 - 6.27	1 - 1.36
Cumulative impacts - Seasons	0.24 - 1.19	0.19 - 1.25	0.02 - 0.66	0.42 - 1.74	0.19 - 9.49	5.21 - 7.6	0.37 - 0.49	6.09 - 6.26	0.84 - 0.98
Cumulative impacts - SlowAssess	0.13 - 0.9	0.22 - 0.54	0.26 - 1.02	2.14 - 36.1	0 - 13.82	2.76 - 9.28	0.45 - 0.53	6.09 - 10.43	1.37 - 5.7
Cumulative impacts - IM	0.21 - 0.76	0.29 - 0.72	0.25 - 1.02	1.13 - 2.12	1.43 - 5.08	1.89 - 9.27	0.37 - 0.5	4.26 - 7.43	1 - 1.06
Expanded LTL fishery - IM	0.68 - 1.7	0.19 - 0.54	0.26 - 1.86	3.97 - 8.97	0.38 - 8.15	2.02 - 2.97	0.46 - 0.63	14.09 - 15.08	2.09 - 2.6
New mesopelgic fishery - IM	0.58 - 2.15	0 - 0.04	5.89 - 7.8	6.18 - 11.85	0.74 - 2.81	2.26 - 3.32	0.58 - 0.72	10.17 - 10.45	3.46 - 4.89
Extreme climate events - IM	0.62 - 1.84	0.01 - 0.07	0.18 - 1.98	3.95 - 88.73	0.1 - 5.61	2.26 - 3.3	0.53 - 0.7	10.16 - 10.43	1.69 - 13.12
Blooms - IM	0.44 - 1.81	0.01 - 0.23	0.18 - 1.96	2.98 - 53.87	0.91 - 1.63	2.26 - 3.31	0.52 - 0.75	10.16 - 10.43	1.64 - 8.36
Primary production regime shift - IM	0.6 - 1.93	0.01 - 0.11	0.18 - 2.05	2.93 - 83.94	1.11 - 3.78	2.26 - 4.52	0.53 - 0.93	4.77 - 10.43	1.56 - 12.46
Fish kills - IM	0.41 - 1.9	0 - 0.12	0.18 - 1.97	2.44 - 88.66	0.65 - 4.61	2.26 - 3.31	0.53 - 0.75	14 - 14.8	1.73 - 13.29
Range extensions - IM	0.64 - 1.74	0.19 - 0.53	0.26 - 1.86	5.32 - 77.76	1.57 - 25.99	2.15 - 3.86	0.46 - 0.64	10.16 - 10.43	2.08 - 11.6
Gear switching allowed - IM	0.67 - 2.27	0.2 - 0.66	0.25 - 1.84	4.7 - 23.15	1.38 - 19.33	1.89 - 2.78	0.5 - 0.69	10.16 - 10.43	2.04 - 4.08
High compliance - IM	0.98 - 1.14	0.2 - 0.53	0.26 - 1.87	1.71 - 12.35	0.27 - 0.73	2.02 - 2.95	0.45 - 0.61	14.73 - 15.25	1.89 - 2.86

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
Low Compliance - IM	0.48 - 2.63	0.2 - 0.55	0.25 - 1.86	5.02 - 33.27	0.78 - 23.97	2.01 - 2.95	0.44 - 0.62	10.15 - 10.43	2.19 - 5.82
Flexible fisher behaviour - IM	1.14 - 1.37	0.55 - 1.31	0.7 - 5.15	1.79 - 11.09	0.31 - 3.8	5.85 - 8.59	0.57 - 0.72	10.15 - 10.43	2.54 - 2.69
Increased fishing pressure drivers - IM	0.87 - 1.49	0.2 - 0.52	0.26 - 1.86	1.5 - 13.1	1.05 - 59.78	2.02 - 2.96	0.43 - 0.61	10.15 - 10.43	1.61 - 4.11
High Cost, Low Values - IM	0.76 - 2.17	0.21 - 0.68	0.25 - 1.87	0.39 - 3.79	1.18 - 25403.79	1.77 - 2.61	0.38 - 0.56	14.64 - 15.8	1.73 - 549.28
Low Costs, High Values - IM	1.25 - 1.52	0.2 - 0.53	0.25 - 1.86	1.89 - 9.29	0.3 - 8.93	2.02 - 2.96	0.44 - 0.61	13.96 - 15.86	1.99 - 2.76
Standard Markets - IM	0.56 - 1.89	0.2 - 0.53	0.26 - 1.87	1.78 - 14.82	3.23 - 19.49	2.02 - 2.96	0.45 - 0.63	10.15 - 10.43	1.62 - 3.15
Technology Creep - IM	0.85 - 2.36	0.39 - 1.09	0.49 - 3.56	4.05 - 40.02	0.57 - 9.3	3.98 - 5.81	0.6 - 0.76	10.15 - 10.43	2.5 - 6.46
No Acclimation - 2010 coastal context - IM	0.91 - 2.67	0.01 - 0.02	0 - 0.01	1 - 7.72	0.18 - 31.28	0.46 - 0.67	1.24 - 1.61	4.67 - 5.57	1.72 - 2.76
No Acclimation - Cumulative impacts - SQ	0.54 - 2.4	0.01 - 0.04	0 - 0.01	0.86 - 32.26	0.21 - 63.85	0.46 - 0.62	1.22 - 1.58	6.68 - 7.68	2.27 - 5.15

Table 33: Range of relative landings (in 2065-2070) by class of organism for Atlantis SEAP under the RCP 4.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
No Climate change - 2010 context - SQ	1.57 - 5.52	0.75 - 1.27	1.14 - 1.53	0.93 - 2.57	0.39 - 1.95	7.29 - 8.43	0.53 - 0.73	6.97 - 7.91	1.37 - 2.55
2010 coastal context - Cap ecosystem take	0.98 - 1.67	0.2 - 0.52	0.26 - 1.87	4.44 - 51	0.58 - 1.05	1.98 - 2.91	0.43 - 0.66	6.65 - 201.19	1.87 - 18.4
2010 coastal context - Centralised mgmt.	1.03 - 1.57	0.2 - 0.52	0.26 - 1.87	5.98 - 24.08	2.15 - 298.57	1.98 - 2.91	0.41 - 0.66	10.44 - 201.17	2.18 - 21.23
2010 coastal context - FewMPA	0.94 - 2.37	0.21 - 0.58	0.26 - 1.87	4.51 - 45.69	0.24 - 16.18	1.68 - 2.48	0.33 - 0.41	10.44 - 201.38	2.41 - 14.4
2010 coastal context - Fragmented mgmt	0.76 - 1.99	0.19 - 0.53	0.26 - 1.87	4.24 - 39.51	0.04 - 3.27	1.98 - 2.91	0.44 - 0.67	10.44 - 201.19	2.04 - 16.86
2010 coastal context - ManyMPA	1.24 - 5.26	0.18 - 0.47	0.26 - 1.79	1.57 - 64.69	0.05 - 1.79	2.06 - 3.13	0.3 - 0.33	10.46 - 201.72	2.32 - 12.01
2010 coastal context - Seasons	0.81 - 2.29	0.01 - 0.43	0.12 - 1.2	4.53 - 13.08	0.38 - 2422.33	1.17 - 1.72	0.51 - 0.75	10.44 - 201.15	1.59 - 54.23
2010 coastal context - SlowAssess	0.88 - 1.09	0.19 - 3.1	0.06 - 1.86	2.07 - 11.4	2.73 - 719.53	2.14 - 17.66	0.49 - 1.98	3.19 - 201.19	5.64 - 16.49
2010 coastal context - Integrated Mgmt (IM)	0.98 - 1.23	0.22 - 2.38	0.06 - 1.87	0.37 - 51	8.6 - 105.1	2.14 - 13.56	0.48 - 0.74	4.46 - 140.57	1.44 - 17.43
Cumulative impacts - 2010 Status Quo (SQ)	0.14 - 0.94	0.26 - 0.5	0.06 - 1.03	0.94 - 8.17	0.24 - 75.65	8.64 - 12.65	0.39 - 0.59	6.26 - 120.7	0.96 - 9.6
Cumulative impacts - Cap ecosystem take	0.21 - 0.72	0.23 - 0.34	0.06 - 1.03	0.84 - 6.08	0.11 - 5.1	8.64 - 12.64	0.38 - 0.58	3.99 - 120.7	0.65 - 7.81
Cumulative impacts - Centralised mgmt.	0.17 - 0.79	0.15 - 0.32	0.06 - 1.03	0.76 - 25.09	0.26 - 14.48	8.65 - 12.65	0.38 - 0.58	6.27 - 120.7	0.78 - 10.55
Cumulative impacts - FewMPA	0.22 - 1.17	0.34 - 0.78	0.06 - 1.03	0.87 - 4.82	0 - 57.38	7.34 - 10.78	0.23 - 0.45	6.26 - 120.82	0.87 - 8.77
Cumulative impacts - Fragmented mgmt	0.18 - 0.94	0.17 - 0.3	0.06 - 1.03	0.73 - 4.54	0.17 - 15.86	8.63 - 12.65	0.39 - 0.58	6.26 - 120.71	0.75 - 7.82
Cumulative impacts - ManyMPA	0.38 - 2.84	0.28 - 0.64	0.06 - 0.99	0.37 - 2.74	0.22 - 83.81	8.99 - 13.6	0.17 - 0.8	6.28 - 121.02	1.06 - 8.92
Cumulative impacts - Seasons	0.21 - 1.16	0.17 - 0.93	0.03 - 0.66	1.17 - 3.75	0.02 - 9.05	5.11 - 7.47	0.39 - 0.53	6.26 - 120.68	0.87 - 7.49
Cumulative impacts - SlowAssess	0.13 - 0.91	0.22 - 0.53	0.27 - 1.03	5.15 - 42.46	0 - 13.25	2.71 - 9.27	0.48 - 0.52	10.44 - 120.7	1.82 - 8.57

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
Cumulative impacts - IM	0.21 - 1.27	0.27 - 0.72	0.26 - 1.03	1.5 - 6.08	0 - 1.41	1.85 - 9.26	0.36 - 0.5	5.5 - 84.34	1.01 - 5.83
Expanded LTL fishery - IM	0.73 - 1.89	0.19 - 0.53	0.26 - 1.87	4.55 - 19.59	0.01 - 3.55	1.98 - 2.91	0.46 - 0.67	15.32 - 207.54	2.34 - 14.46
New mesopelgic fishery - IM	0.75 - 2.18	0 - 0.03	1.55 - 2435.79	6.02 - 33.25	0 - 2.78	2.22 - 3.26	0.57 - 0.77	10.46 - 201.48	2.36 - 716.04
Extreme climate events - IM	0.53 - 2.43	0.01 - 0.05	0.19 - 2	3.88 - 19.35	0.01 - 0.26	2.22 - 3.25	0.53 - 0.75	10.44 - 201.2	1.75 - 14.1
Blooms - IM	0.44 - 2.4	0.01 - 0.17	0.19 - 1.98	3.5 - 63.44	0 - 1.64	2.21 - 3.25	0.51 - 0.8	10.44 - 201.2	1.72 - 13.28
Primary production regime shift - IM	0.88 - 2.55	0.01 - 0.08	0.19 - 2.07	10.3 - 24.42	0 - 2.95	2.22 - 4.51	0.52 - 0.96	10.44 - 94.52	2.66 - 9.37
Fish kills - IM	0.46 - 2.33	0 - 0.09	0.19 - 2	9.52 - 11.84	0 - 0.66	2.22 - 3.25	0.52 - 0.8	15.82 - 206.1	2.73 - 13.35
Range extensions - IM	0.79 - 1.91	0.19 - 0.53	0.27 - 1.87	9.34 - 29.05	0.08 - 2.57	2.14 - 3.79	0.48 - 0.67	10.44 - 201.21	2.44 - 15.13
Gear switching allowed - IM	0.89 - 2.49	0.2 - 0.57	0.26 - 1.84	5.73 - 27.21	0 - 19.09	1.86 - 2.73	0.5 - 0.73	10.44 - 201.26	2.72 - 14.62
High compliance - IM	1.1 - 1.42	0.2 - 0.52	0.26 - 1.87	12.62 - 61.1	0 - 0.36	1.98 - 2.9	0.45 - 0.66	14.41 - 205.1	3.19 - 20
Low Compliance - IM	0.82 - 2.67	0.2 - 0.54	0.26 - 1.87	4.15 - 39.13	0.02 - 0.79	1.97 - 2.9	0.43 - 0.66	10.44 - 201.13	2.16 - 15.66
Flexible fisher behaviour - IM	1.22 - 1.67	0.55 - 1.29	0.72 - 5.16	5.59 - 56.56	0 - 3.75	5.74 - 8.44	0.56 - 0.78	10.44 - 201.19	2.64 - 20.18
Increased fishing pressure drivers - IM	0.98 - 2.23	0.2 - 0.52	0.26 - 1.87	4.44 - 51	0.06 - 9.22	1.98 - 2.91	0.43 - 0.66	10.44 - 201.19	2.05 - 18.4
High Cost, Low Values - IM	0.97 - 1.9	0.21 - 0.57	0.26 - 1.87	3 - 4.85	0.02 - 16.47	1.74 - 2.56	0.37 - 0.59	14.49 - 206.33	1.6 - 12.49
Low Costs, High Values - IM	1.3 - 2.11	0.2 - 0.53	0.26 - 1.86	4.53 - 70.03	0 - 1.5	1.98 - 2.91	0.44 - 0.65	15.67 - 206.48	2.15 - 21.36
Standard Markets - IM	0.66 - 1.96	0.2 - 0.53	0.26 - 1.87	4.24 - 17.4	0.07 - 3.24	1.98 - 2.91	0.45 - 0.67	10.44 - 201.19	2.04 - 12.6
Technology Creep - IM	0.87 - 2.57	0.39 - 1.08	0.5 - 3.57	8.11 - 47.04	0.56 - 10.61	3.9 - 5.71	0.63 - 0.82	10.44 - 201.19	3.14 - 14.64
No Acclimation - 2010 coastal context - IM	1.09 - 2.85	0.01 - 0.02	0 - 0.01	3.08 - 6.53	0.17 - 31.41	0.45 - 0.66	1.51 - 1.81	4.8 - 92.51	1.65 - 6.8
No Acclimation - Cumulative impacts - SQ	0.72 - 2.63	0.01 - 0.03	0 - 0.01	3.75 - 35.34	0.88 - 96.84	0.45 - 0.61	1.3 - 1.8	6.74 - 132.41	4.17 - 10.12

Table 34: Range of relative landings (in 2065-2070) by class of organism for Atlantis SEAP under the RCP 8.5 emissions scenario

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
No Climate change - 2010 context - SQ	1.57 - 5.52	0.75 - 1.27	1.14 - 1.53	0.93 - 2.57	0.39 - 1.95	7.29 - 8.43	0.53 - 0.73	6.97 - 7.91	1.37 - 2.55
2010 coastal context - Cap ecosystem take	0.75 - 10.01	0.65 - 1.17	4.81 - 9.17	4.05 - 16.64	1.72 - 21.52	8.28 - 8.38	0.34 - 0.43	6.65 - 10.39	3.36 - 8.05
2010 coastal context - Centralised mgmt.	0.94 - 4.17	0.68 - 1.14	4.82 - 9.13	2.19 - 133.13	0.04 - 864.38	8.29 - 8.39	0.35 - 0.41	10.38 - 10.44	3.77 - 40.58
2010 coastal context - FewMPA	1.31 - 4.42	0.52 - 1.41	4.9 - 8.92	1.98 - 48.25	0.3 - 29.64	7.06 - 7.12	0.25 - 0.33	10.39 - 10.44	3.28 - 11.34
2010 coastal context - Fragmented mgmt	1.3 - 8.55	0.78 - 1.32	4.87 - 9.18	3.12 - 121.49	3.59 - 8.32	8.28 - 8.39	0.35 - 0.45	10.38 - 10.44	3.97 - 21.6
2010 coastal context - ManyMPA	2.63 - 21.8	0.58 - 1.09	4.36 - 8.3	0.77 - 67.86	3.33 - 5.5	8.67 - 8.91	0.13 - 0.16	10.41 - 10.46	3.04 - 17.07
2010 coastal context - Seasons	1.47 - 7.39	0.08 - 0.17	1.16 - 1.64	1.04 - 22.73	4.75 - 4522.02	4.89 - 4.93	0.31 - 0.37	10.38 - 10.43	1.78 - 100.65

Scenario	Demersal Fish	Pelagic Fish	Forage Fish	Sharks and Rays	Cephalopods	Filter feeders	Macrozoobenthos	New invert fisheries	Total
2010 coastal context - SlowAssess	0.88 - 2.67	0.54 - 1.16	2.43 - 6.75	0.9 - 6.96	6.95 - 2261.5	8.39 - 74.38	0.37 - 0.62	2.92 - 10.38	4.33 - 51.07
2010 coastal context - Integrated Mgmt (IM)	1.03 - 4.74	0.74 - 1.18	2.4 - 6.96	0.96 - 3.79	0.03 - 13.81	8.38 - 38.95	0.37 - 0.42	4.46 - 7.26	1.77 - 4.11
Cumulative impacts - 2010 Status Quo (SQ)	0.43 - 1.01	0.49 - 1.05	2.39 - 4.25	0.65 - 3.88	0.04 - 4105.51	36.03 - 36.39	0.16 - 0.26	6.23 - 6.26	1.36 - 90.69
Cumulative impacts - Cap ecosystem take	0.62 - 1.06	0.48 - 1.05	2.36 - 4.31	1.11 - 3.75	0.13 - 1184.66	36 - 36.4	0.16 - 0.25	3.99 - 6.23	1.55 - 27.22
Cumulative impacts - Centralised mgmt.	0.66 - 0.99	0.49 - 1.01	2.37 - 4.23	1.9 - 5.48	0 - 140.69	36.04 - 36.41	0.16 - 0.26	6.23 - 6.26	1.66 - 5.4
Cumulative impacts - FewMPA	0.33 - 0.97	0.56 - 0.84	2.26 - 4.1	1.74 - 2.25	0.04 - 144.52	30.7 - 30.92	0.1 - 0.18	6.23 - 6.26	1.56 - 4.89
Cumulative impacts - Fragmented mgmt	0.54 - 1.04	0.49 - 1.03	2.39 - 4.24	0.65 - 5.05	0.44 - 2100.84	36.03 - 36.36	0.16 - 0.26	6.23 - 6.26	1.37 - 47.63
Cumulative impacts - ManyMPA	1.06 - 1.69	0.43 - 1.08	2.08 - 3.71	0.26 - 3.08	0.41 - 2683.67	37.83 - 38.73	0.08 - 0.13	6.25 - 6.28	1.43 - 59.89
Cumulative impacts - Seasons	0.34 - 1.05	0.06 - 0.11	0.63 - 0.93	0.45 - 0.99	0.06 - 22.76	21.28 - 21.52	0.17 - 0.24	6.23 - 6.26	0.81 - 1.54
Cumulative impacts - SlowAssess	0.39 - 2.29	0.77 - 0.92	4.19 - 9.17	1.05 - 44.76	0 - 2.25	7.72 - 36.26	0.18 - 0.36	6.23 - 10.44	1.9 - 9.89
Cumulative impacts - IM	0.44 - 4.15	0.77 - 1.04	4.31 - 9.06	0.74 - 12.51	0.49 - 2.64	7.71 - 36.21	0.19 - 0.29	4.35 - 7.44	1.88 - 5.73
Expanded LTL fishery - IM	1.35 - 3.61	0.75 - 1.25	4.92 - 9.25	6.51 - 108.24	0.96 - 6.63	8.3 - 8.39	0.35 - 0.46	15.27 - 16.2	4.51 - 18.95
New mesopelgic fishery - IM	0.87 - 4.94	0.13 - 0.27	3.25 - 17.53	2.52 - 14.71	0.18 - 0.52	9.28 - 9.4	0.3 - 0.44	10.4 - 10.46	3.22 - 8.3
Extreme climate events - IM	0.78 - 5.98	0.13 - 0.27	2.22 - 3.02	6.28 - 109.42	0.25 - 0.66	9.25 - 9.36	0.4 - 0.44	10.38 - 10.44	2.44 - 17.31
Blooms - IM	0.74 - 6.31	0.13 - 0.28	2.19 - 3.04	4.57 - 66.55	0.15 - 4.17	9.26 - 9.37	0.43 - 0.51	10.38 - 10.44	2.43 - 11.64
Primary production regime shift - IM	0.7 - 5.28	0.13 - 0.28	2.22 - 3.05	4.96 - 103.51	0.04 - 2.05	9.24 - 17.64	0.4 - 0.46	4.88 - 10.44	2.28 - 16.56
Fish kills - IM	0.58 - 7.17	0.13 - 0.27	2.22 - 3.03	3.85 - 109.34	0.54 - 1.67	9.26 - 9.38	0.32 - 0.46	17.04 - 17.51	2.42 - 17.66
Range extensions - IM	1.13 - 7.19	0.79 - 0.98	4.87 - 9.28	2.4 - 96.16	4.02 - 9.38	8.29 - 15.96	0.35 - 0.52	10.39 - 10.44	4.01 - 18.08
Gear switching allowed - IM	1.43 - 4.25	0.82 - 1.06	4.87 - 8.88	7.77 - 28.86	0.36 - 3.56	7.78 - 7.85	0.29 - 0.39	10.39 - 10.44	4.67 - 8
High compliance - IM	0.7 - 4.75	0.76 - 1.06	4.83 - 9.13	4.71 - 149.55	0.05 - 0.92	8.27 - 8.39	0.33 - 0.45	14.64 - 15.27	3.16 - 24.36
Low Compliance - IM	1.55 - 3.74	0.78 - 0.89	4.98 - 9.13	2.74 - 41.33	0.28 - 2	8.27 - 8.37	0.34 - 0.43	10.38 - 10.44	3.64 - 9.71
Flexible fisher behaviour - IM	1.18 - 5.52	0.78 - 1.02	11.85 - 25.03	4.32 - 131.1	0.09 - 0.78	24.03 - 24.31	0.39 - 0.48	10.38 - 10.44	5.79 - 26.29
Increased fishing pressure drivers - IM	0.75 - 10.01	0.78 - 0.91	4.81 - 9.17	4.05 - 158.77	7.04 - 26.74	8.28 - 8.38	0.34 - 0.43	10.38 - 10.44	3.71 - 26.97
High Cost, Low Values - IM	1.49 - 4.76	0.89 - 1.29	4.88 - 8.95	0.86 - 6.24	3.02 - 2992.99	7.3 - 7.35	0.24 - 0.38	14.6 - 17.49	3.52 - 69.66
Low Costs, High Values - IM	1.04 - 29.04	0.87 - 0.93	4.87 - 9.13	5.21 - 11.62	0.77 - 16.33	8.28 - 8.39	0.34 - 0.44	15.17 - 18.04	3.91 - 10.08
Standard Markets - IM	1.23 - 8.22	0.8 - 0.95	4.87 - 9.16	5.42 - 18.77	0.84 - 8.24	8.28 - 8.39	0.35 - 0.45	10.38 - 10.44	4.16 - 7.7
Technology Creep - IM	1.66 - 8.54	0.91 - 1.25	8.44 - 17.36	6.54 - 49.53	0.47 - 0.68	16.27 - 16.43	0.34 - 0.46	10.38 - 10.44	6.33 - 14.32
No Acclimation - 2010 coastal context - IM	1.43 - 34.08	0.45 - 0.98	0.14 - 0.31	1.37 - 16.02	5.15 - 21.05	1.87 - 1.89	0.8 - 0.96	4.77 - 5.57	3.09 - 9.53
No Acclimation - Cumulative impacts - SQ	1.28 - 27.88	0.47 - 0.98	0.15 - 0.31	1.57 - 78.46	1.65 - 25164.11	1.74 - 1.89	0.66 - 0.98	6.73 - 7.68	7.81 - 550.07

doubles or more. The other major exception is when the gear is used in a new fishery. Trap and line fisheries under RCP 4.5 also increase when ever regulations are loosened – when there is little spatial management, a reliance on seasonal management, low compliance, low costs (or high product values) – or when fishing pressure intensifies or there is a regime shift in productivity. As the CPUE based model only allows for effort increases when CPUE rises above threshold values this indicates that catch rates for at least one group must increase sufficiently in these cases to drive the increased effort. In many cases these groups driving the effort expansion are not ones historically considered prime fisheries targets.

As for Atlantis-SE, gear switching of any particular volume is usually restricted to when the system productivity was low or there were significant blooms. In this model net fisheries see the greatest reduction in fleet size under all emission scenarios. There is also a reduction in the size of the trawl fleet under RCP 8.5. Any change in fleet size for the other gear types under the different scenarios and strategies is not significant.

AQUACULTURE

The future of aquaculture production is dependent on the level of emissions, the taxa and whether production facilities are in the ocean or on land (Tables 38-40). Prawn production, as represented in the model, is on land for the entire life history and so can be buffered from the climate and other effects. The market demand for prawns remains sufficiently high that there is an increasing expansion of the prawn aquaculture in NSW. There are similar levels of expansion under RCP 3 and 4.5 – where production regularly increases by 50% or more (sometimes doubling or trebling) unless intensive competition for the coastal zone (in cumulative impacts simulations) prevent the industry access suitable coastal properties and water supplies. In these later cases increases in production are <20%. Increases are also modest (or non-existent) under high emission scenarios as the costs of maintaining facilities under these conditions proved prohibitive unless shifts in ocean productivity was assumed to negatively impact wild stock production (driving up prices and demand).

The strong growth in the ranching of bivalves continues in the model if heat and acidification tolerant strains are found; although partial onshore grow out of spat and seeding with juveniles is necessary under some productivity parameterisations. There is also strong growth of onshore culturing of abalone. This is true in all cases as demand rises in response to the decline in stock and landings of wild stock, particularly with rising emissions and cumulative impacts. Overall the production of cultured shellfish (bivalves and abalone together) increases by more than a 1000x when there is integrated management of the coastal zone (ensuring access to suitable culture locations) or when cumulative impacts, disease or range extensions disrupt demersal stocks and impact supply from wild caught stocks.

The production of southern bluefin tuna does not appear to be particularly heavily impacted by climate change, as the pens are in waters that do not shift outside the thermal tolerance of the species (and it is assumed that if storms or waves become problems that technological solutions will be found). However, production does not grow substantially either (<20% at most and more typically < 5%). This is in large part due to the fact Atlantis-SE suggests southern bluefin tuna stocks won't grow by much and so the Australian allocation assumed in Atlantis-SEAP doesn't not increase substantially. It is also assumed that no new species of tuna are farmed in the southeast Australian region, with fishing on range extending wild stocks meeting recreational and commercial demand in the region.

Salmon aquaculture shows the greatest differential outcomes under the different emission scenarios. Under RCP 3 growth is possible, particularly under management strategies where regulatory access to wild finfish is constrained. However, under the lower productivity, more vulnerable parameterisations, even the low level of warming and acidification seen under RCP 3 can see production drop by up to 25%. Under RCP 4.5 production declines are more common, becoming pervasive under cumulative impacts (where production could be halved). Increases in production (even a doubling) are possible but require robust productivity parameterisations, technology improvements, effective coastal zone management or a faltering of the supply of high quality wild caught product. Under RCP 8.5 the situation is dire for salmon aquaculture, with few if any suitable locations production declines by 60-80% (by as much as 95% if there is no acclimation). This kind of drop in production would likely mean the industry ceases to operate in southeast Australian waters.

Table 35: Range of relative effort in 2065-2070 per gear class in Atlantis-SEAP under RCP 3.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.85 - 1.53	0.3 - 0.61	0.86 - 1.24	1.02 - 1.13	0.58 - 1.44
2010 coastal context - Cap ecosystem take	0.36 - 0.91	0.09 - 0.28	0.47 - 0.92	0.51 - 0.78	0.51 - 0.98
2010 coastal context - Centralised mgmt.	0.36 - 0.91	0.09 - 0.28	0.47 - 0.92	0.52 - 0.78	0.52 - 0.98
2010 coastal context - FewMPA	0.54 - 4.23	0.22 - 0.62	0.28 - 0.64	0.86 - 17.57	0.64 - 1.26
2010 coastal context - Fragmented mgmt	0.26 - 0.9	0.09 - 0.28	0.47 - 0.92	0.52 - 0.84	0.51 - 0.98
2010 coastal context - ManyMPA	0.09 - 0.81	0.09 - 0.26	0.26 - 0.47	0.21 - 0.46	0.36 - 0.63
2010 coastal context - Seasons	0.08 - 1.46	0.12 - 0.34	0.27 - 0.51	0.44 - 8.36	0.37 - 0.67
2010 coastal context - SlowAssess	0.35 - 1.13	0.12 - 0.36	0.47 - 0.92	0.52 - 0.78	0.52 - 0.97
2010 coastal context - Integrated Mgmt (IM)	0.36 - 0.91	0.09 - 0.28	0.47 - 0.92	0.51 - 0.78	0.51 - 0.98
Cumulative impacts - 2010 Status Quo (SQ)	0.14 - 0.87	0.08 - 0.23	0.46 - 0.89	0.61 - 1.27	0.48 - 0.91
Cumulative impacts - Cap ecosystem take	0.14 - 0.9	0.08 - 0.24	0.46 - 0.89	0.59 - 0.74	0.48 - 0.92
Cumulative impacts - Centralised mgmt.	0.13 - 0.83	0.08 - 0.24	0.46 - 0.89	0.6 - 0.74	0.48 - 0.92
Cumulative impacts - FewMPA	0.16 - 3.97	0.18 - 0.54	0.27 - 0.62	0.81 - 46.7	0.6 - 1.19
Cumulative impacts - Fragmented mgmt	0.13 - 0.86	0.08 - 0.24	0.46 - 0.89	0.61 - 0.83	0.48 - 0.92
Cumulative impacts - ManyMPA	0.08 - 0.89	0.08 - 0.22	0.25 - 0.46	0.2 - 0.81	0.33 - 0.59
Cumulative impacts - Seasons	0.08 - 1.37	0.1 - 0.29	0.26 - 0.5	0.41 - 22.16	0.34 - 0.63
Cumulative impacts - SlowAssess	0.14 - 1.23	0.1 - 0.31	0.46 - 0.89	0.61 - 0.74	0.48 - 0.92
Cumulative impacts - IM	0.14 - 0.9	0.08 - 0.24	0.46 - 0.89	0.59 - 0.74	0.48 - 0.92
Expanded LTL fishery - IM	0.36 - 0.85	0.09 - 0.27	0.47 - 0.92	0.71 - 0.78	0.52 - 0.98
New mesopelgic fishery - IM	0.4 - 0.88	0.09 - 0.27	0.47 - 0.92	0.71 - 0.78	0.52 - 0.98
Extreme climate events - IM	0.34 - 0.91	0.09 - 0.28	0.47 - 0.92	0.5 - 0.78	0.51 - 0.97
Blooms - IM	0.34 - 0.91	0.1 - 0.28	0.47 - 0.92	0.5 - 0.78	0.51 - 0.99
Primary production regime shift - IM	0.34 - 1.29	0.09 - 0.28	0.47 - 0.92	0.5 - 7.11	0.51 - 0.98
Fish kills - IM	0.35 - 0.91	0.09 - 0.29	0.47 - 0.92	0.5 - 0.78	0.51 - 0.98
Range extensions - IM	0.34 - 0.92	0.09 - 0.28	0.47 - 0.92	0.52 - 1.07	0.51 - 0.98
Gear switching allowed - IM	0.39 - 2.35	0.13 - 0.33	0.49 - 0.96	0.8 - 8.03	0.58 - 1.1
High compliance - IM	0.18 - 1.14	0.09 - 0.29	0.47 - 0.92	0.5 - 2.84	0.51 - 0.98
Low Compliance - IM	0.14 - 0.9	0.1 - 0.25	0.47 - 0.92	0.6 - 0.76	0.51 - 0.97
Flexible fisher behaviour - IM	0.44 - 1.03	0.12 - 0.35	1.41 - 2.73	1.35 - 2.69	1.28 - 2.66
Increased fishing pressure drivers - IM	0.36 - 0.91	0.09 - 0.28	0.47 - 0.92	0.51 - 0.78	0.51 - 0.98
High Cost, Low Values - IM	0.46 - 161.34	0.16 - 0.5	0.52 - 1	0.84 - 13.52	0.65 - 1.24
Low Costs, High Values - IM	0.28 - 1.32	0.09 - 0.27	0.47 - 0.92	0.61 - 10.16	0.52 - 0.98
Standard Markets - IM	0.35 - 0.95	0.09 - 0.27	0.47 - 0.92	0.64 - 0.93	0.51 - 0.97
Technology Creep - IM	0.26 - 34.86	0.07 - 0.19	0.47 - 0.92	0.77 - 6.3	0.52 - 0.99
No Acclimation - 2010 coastal context - IM	5.73 - 29.01	0.01 - 0.03	1.32 - 4.32	2.34 - 5.05	4.67 - 6.32
No Acclimation - Cumulative impacts - SQ	4.75 - 27.85	0.01 - 0.03	1.27 - 4.32	1.97 - 4.24	4.69 - 7.65

Table 36: Range of relative effort in 2065-2070 per gear class in Atlantis-SEAP under RCP 4.5.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.85 - 1.53	0.3 - 0.61	0.86 - 1.24	1.02 - 1.13	0.58 - 1.44
2010 coastal context - Cap ecosystem take	0.35 - 0.84	0.09 - 0.28	0.47 - 0.92	0.52 - 0.79	0.51 - 0.98
2010 coastal context - Centralised mgmt.	0.35 - 0.83	0.09 - 0.28	0.47 - 0.92	0.52 - 0.79	0.52 - 0.98
2010 coastal context - FewMPA	0.53 - 3.23	0.22 - 0.62	0.28 - 0.64	0.89 - 18.92	0.64 - 1.26
2010 coastal context - Fragmented mgmt	0.26 - 0.82	0.1 - 0.28	0.47 - 0.92	0.53 - 0.84	0.51 - 0.98
2010 coastal context - ManyMPA	0.09 - 0.78	0.09 - 0.26	0.26 - 0.47	0.22 - 0.47	0.36 - 0.64
2010 coastal context - Seasons	0.08 - 1.15	0.12 - 0.34	0.27 - 0.51	0.45 - 9	0.36 - 0.67
2010 coastal context - SlowAssess	0.34 - 1.11	0.12 - 0.36	0.47 - 0.92	0.53 - 0.79	0.52 - 0.97
2010 coastal context - Integrated Mgmt (IM)	0.35 - 0.84	0.09 - 0.28	0.47 - 0.92	0.52 - 0.79	0.51 - 0.98
Cumulative impacts - 2010 Status Quo (SQ)	0.13 - 0.8	0.08 - 0.23	0.46 - 0.89	0.61 - 1.27	0.47 - 0.92
Cumulative impacts - Cap ecosystem take	0.13 - 0.88	0.08 - 0.24	0.46 - 0.89	0.6 - 0.75	0.47 - 0.92
Cumulative impacts - Centralised mgmt.	0.13 - 0.79	0.08 - 0.24	0.46 - 0.89	0.62 - 0.75	0.48 - 0.92
Cumulative impacts - FewMPA	0.16 - 3.02	0.19 - 0.53	0.27 - 0.62	0.84 - 50.48	0.6 - 1.19
Cumulative impacts - Fragmented mgmt	0.13 - 0.84	0.08 - 0.24	0.46 - 0.89	0.63 - 0.83	0.47 - 0.93
Cumulative impacts - ManyMPA	0.08 - 0.86	0.08 - 0.22	0.25 - 0.46	0.21 - 0.84	0.33 - 0.6
Cumulative impacts - Seasons	0.08 - 1.07	0.1 - 0.29	0.26 - 0.5	0.42 - 23.95	0.34 - 0.63
Cumulative impacts - SlowAssess	0.14 - 1.2	0.1 - 0.31	0.46 - 0.89	0.63 - 0.75	0.48 - 0.92
Cumulative impacts - IM	0.13 - 0.88	0.08 - 0.24	0.46 - 0.89	0.6 - 0.75	0.47 - 0.92
Expanded LTL fishery - IM	0.35 - 0.83	0.1 - 0.27	0.47 - 0.92	0.71 - 0.79	0.52 - 0.99
New mesopelgic fishery - IM	0.39 - 0.86	0.1 - 0.27	0.47 - 0.92	0.71 - 0.79	0.52 - 0.99
Extreme climate events - IM	0.34 - 0.83	0.1 - 0.28	0.47 - 0.92	0.51 - 0.79	0.51 - 0.97
Blooms - IM	0.34 - 0.84	0.1 - 0.28	0.47 - 0.92	0.5 - 0.79	0.51 - 0.99
Primary production regime shift - IM	0.34 - 1.04	0.1 - 0.28	0.47 - 0.92	0.51 - 7.11	0.51 - 0.98
Fish kills - IM	0.34 - 0.84	0.1 - 0.29	0.47 - 0.92	0.5 - 0.79	0.51 - 0.98
Range extensions - IM	0.33 - 0.84	0.1 - 0.28	0.47 - 0.92	0.53 - 1.07	0.51 - 0.98
Gear switching allowed - IM	0.39 - 24.14	0.13 - 0.33	0.49 - 0.96	0.81 - 8.03	0.57 - 1.1
High compliance - IM	0.17 - 1.03	0.1 - 0.29	0.47 - 0.92	0.5 - 2.84	0.51 - 0.98
Low Compliance - IM	0.14 - 0.82	0.1 - 0.25	0.47 - 0.92	0.61 - 0.77	0.5 - 0.97
Flexible fisher behaviour - IM	0.44 - 0.94	0.12 - 0.35	1.41 - 2.73	1.35 - 2.69	1.28 - 2.66
Increased fishing pressure drivers - IM	0.35 - 0.84	0.09 - 0.28	0.47 - 0.92	0.52 - 0.79	0.51 - 0.98
High Cost, Low Values - IM	0.45 - 154.69	0.17 - 0.5	0.52 - 1	0.87 - 13.52	0.65 - 1.24
Low Costs, High Values - IM	0.27 - 1.13	0.09 - 0.27	0.47 - 0.92	0.62 - 10.16	0.52 - 0.98
Standard Markets - IM	0.34 - 0.87	0.09 - 0.27	0.47 - 0.92	0.64 - 0.93	0.51 - 0.97
Technology Creep - IM	0.26 - 33.43	0.07 - 0.19	0.47 - 0.92	0.78 - 6.48	0.52 - 1
No Acclimation - 2010 coastal context - IM	4.2 - 28.5	0.01 - 0.03	1.32 - 4.32	2.44 - 5.07	4.67 - 6.31
No Acclimation - Cumulative impacts - SQ	3.51 - 27.37	0.01 - 0.03	1.27 - 4.32	1.97 - 4.26	4.68 - 7.66

Table 37: Range of relative effort in 2065-2070 per gear class in Atlantis-SEAP under RCP 8.5.

Scenario	Trawl	Net	Purse Seine	Trap or Line	Invertebrate fisheries
No Climate change - 2010 context - SQ	0.85 - 1.53	0.3 - 0.61	0.86 - 1.24	1.02 - 1.13	0.58 - 1.44
2010 coastal context - Cap ecosystem take	0.36 - 0.9	0.07 - 0.23	0.47 - 0.92	0.47 - 0.78	0.51 - 0.98
2010 coastal context - Centralised mgmt.	0.34 - 0.9	0.07 - 0.23	0.47 - 0.92	0.46 - 0.78	0.52 - 0.97
2010 coastal context - FewMPA	0.55 - 1.2	0.17 - 0.5	0.28 - 0.64	0.63 - 0.85	0.64 - 1.25
2010 coastal context - Fragmented mgmt	0.26 - 0.89	0.07 - 0.23	0.47 - 0.92	0.46 - 0.79	0.51 - 0.98
2010 coastal context - ManyMPA	0.09 - 0.54	0.07 - 0.21	0.26 - 0.47	0.13 - 0.21	0.36 - 0.63
2010 coastal context - Seasons	0.09 - 0.57	0.09 - 0.27	0.27 - 0.51	0.32 - 0.44	0.36 - 0.66
2010 coastal context - SlowAssess	0.35 - 0.9	0.09 - 0.29	0.47 - 0.92	0.45 - 0.78	0.52 - 0.97
2010 coastal context - Integrated Mgmt (IM)	0.36 - 0.9	0.07 - 0.23	0.47 - 0.92	0.47 - 0.78	0.51 - 0.98
Cumulative impacts - 2010 Status Quo (SQ)	0.09 - 0.58	0.14 - 0.15	1.27 - 7.53	1.1 - 4.16	3.54 - 4.26
Cumulative impacts - Cap ecosystem take	0.09 - 0.57	0.15 - 0.16	1.27 - 7.53	1.1 - 4.16	3.49 - 4.01
Cumulative impacts - Centralised mgmt.	0.09 - 0.55	0.15 - 0.16	1.27 - 7.53	1.09 - 4.16	3.53 - 4.23
Cumulative impacts - FewMPA	0.11 - 0.76	0.33 - 0.36	1.2 - 7.67	1.23 - 4.51	5.09 - 5.44
Cumulative impacts - Fragmented mgmt	0.09 - 0.54	0.15 - 0.16	1.27 - 7.53	1.09 - 4.23	3.54 - 4.25
Cumulative impacts - ManyMPA	0.06 - 0.34	0.14 - 0.15	0.55 - 3.04	0.33 - 1.43	2.65 - 3.24
Cumulative impacts - Seasons	0.05 - 0.35	0.18 - 0.19	0.68 - 3.96	0.62 - 2.26	2.6 - 2.72
Cumulative impacts - SlowAssess	0.09 - 0.57	0.19 - 0.2	1.27 - 7.53	1.09 - 4.16	3.48 - 4.23
Cumulative impacts - IM	0.09 - 0.57	0.15 - 0.16	1.27 - 7.53	1.1 - 4.16	3.49 - 4.01
Expanded LTL fishery - IM	0.33 - 0.73	0.07 - 0.22	0.47 - 0.92	0.47 - 0.78	0.52 - 0.97
New mesopelgic fishery - IM	0.37 - 0.74	0.07 - 0.22	0.47 - 0.92	0.47 - 0.78	0.52 - 0.97
Extreme climate events - IM	0.35 - 0.9	0.07 - 0.23	0.47 - 0.92	0.47 - 0.78	0.51 - 0.97
Blooms - IM	0.35 - 0.9	0.08 - 0.23	0.47 - 0.92	0.46 - 0.78	0.51 - 0.98
Primary production regime shift - IM	0.35 - 0.63	0.07 - 0.23	0.47 - 0.92	0.45 - 0.78	0.51 - 0.98
Fish kills - IM	0.35 - 0.9	0.07 - 0.24	0.47 - 0.92	0.46 - 0.78	0.51 - 0.98
Range extensions - IM	0.34 - 0.9	0.07 - 0.23	0.47 - 0.92	0.46 - 0.82	0.52 - 0.97
Gear switching allowed - IM	0.4 - 1.08	0.1 - 0.27	0.49 - 0.96	0.51 - 0.8	0.58 - 1.09
High compliance - IM	0.18 - 1.08	0.07 - 0.23	0.47 - 0.92	0.45 - 0.78	0.51 - 0.98
Low Compliance - IM	0.14 - 0.9	0.08 - 0.21	0.47 - 0.92	0.47 - 0.76	0.5 - 0.97
Flexible fisher behaviour - IM	0.45 - 0.99	0.09 - 0.29	1.41 - 2.73	1.29 - 2.26	1.28 - 2.65
Increased fishing pressure drivers - IM	0.36 - 0.9	0.07 - 0.23	0.47 - 0.92	0.47 - 0.78	0.51 - 0.98
High Cost, Low Values - IM	0.47 - 1.3	0.13 - 0.4	0.52 - 1	0.58 - 0.84	0.65 - 1.23
Low Costs, High Values - IM	0.28 - 0.92	0.07 - 0.22	0.47 - 0.92	0.46 - 0.78	0.52 - 0.98
Standard Markets - IM	0.35 - 0.95	0.07 - 0.22	0.47 - 0.92	0.47 - 0.77	0.51 - 0.97
Technology Creep - IM	0.27 - 0.39	0.05 - 0.15	0.47 - 0.92	0.49 - 0.77	0.52 - 0.98
No Acclimation - 2010 coastal context - IM	0.68 - 29.2	0.01 - 0.02	1.32 - 4.32	1.19 - 5.05	4.33 - 5.07
No Acclimation - Cumulative impacts - SQ	0.64 - 28.04	0.01 - 0.02	1.27 - 4.32	1.11 - 4.24	4.08 - 6.5

Table 38: Range of relative aquaculture production (in 2065-2070) in Atlantis-SEAP under RCP 3.

Scenario	Aquaculture Salmon	Aquaculture Tuna	Aquaculture Oysters Mussels and Abalone	Aquaculture Prawns
No Climate change - 2010 context - SQ	1.06 - 1.28	1.1 - 1.17	30.12 - 971.43	1.11 - 2.02
2010 coastal context - Cap ecosystem take	1.12 - 1.66	1.06 - 1.11	7.33 - 542.44	1.8 - 3.5
2010 coastal context - Centralised mgmt.	1.02 - 1.24	1.07 - 1.1	17.02 - 107.85	1.6 - 2.16
2010 coastal context - FewMPA	0.86 - 1.12	1.13 - 1.16	32.17 - 50.5	1.86 - 2.75
2010 coastal context - Fragmented mgmt	0.78 - 1.02	1.07 - 1.12	12.31 - 29.98	1.53 - 2.06
2010 coastal context - ManyMPA	0.94 - 3.54	1.05 - 1.09	19.93 - 78.46	1.85 - 2.13
2010 coastal context - Seasons	1.28 - 1.73	1.04 - 1.16	33.4 - 65.36	1.36 - 1.52
2010 coastal context - SlowAssess	0.82 - 1.23	1.06 - 1.14	11.86 - 15.02	3.75 - 5.56
2010 coastal context - Integrated Mgmt (IM)	0.82 - 3.88	1.04 - 1.15	49.82 - 3491.64	1.61 - 2.63
Cumulative impacts - 2010 Status Quo (SQ)	1 - 1.2	1.06 - 1.14	42.88 - 1637.19	1.54 - 2.78
Cumulative impacts - Cap ecosystem take	0.74 - 2.17	1.04 - 1.09	288.57 - 531.22	1.11 - 1.12
Cumulative impacts - Centralised mgmt.	0.78 - 0.93	1.1 - 1.12	563.13 - 843.36	1.06 - 1.14
Cumulative impacts - FewMPA	0.8 - 0.91	1.04 - 1.09	226.25 - 1376.67	1.05 - 1.21
Cumulative impacts - Fragmented mgmt	0.81 - 0.86	1.03 - 1.13	279.86 - 981.89	1.12 - 1.17
Cumulative impacts - ManyMPA	0.86 - 2.14	1.06 - 1.11	601.93 - 1472.49	1.11 - 1.16
Cumulative impacts - Seasons	0.82 - 0.94	1.03 - 1.14	415.36 - 823.62	0.98 - 1.05
Cumulative impacts - SlowAssess	0.79 - 1	1.03 - 1.07	142.92 - 219.11	1.35 - 1.77
Cumulative impacts - IM	0.73 - 0.95	1.05 - 1.14	60.3 - 313.65	1.16 - 1.46
Expanded LTL fishery - IM	0.87 - 1.08	1.04 - 1.05	13.78 - 763.35	1.15 - 1.38
New mesopelgic fishery - IM	0.85 - 1.07	1.08 - 1.15	21.22 - 52.94	1.8 - 2.11
Extreme climate events - IM	0.93 - 1.44	1.05 - 1.11	31.64 - 46.72	2.41 - 3.12
Blooms - IM	1 - 1.51	1.1 - 1.14	32.21 - 91.24	2.41 - 3.2
Primary production regime shift - IM	0.93 - 1.39	1.07 - 1.13	52.02 - 60.24	2.08 - 2.86
Fish kills - IM	0.99 - 1.26	1.04 - 1.11	46.07 - 125.79	2.35 - 3.29
Range extensions - IM	1.07 - 1.61	1.1 - 1.1	35.51 - 59.33	2.16 - 3.53
Gear switching allowed - IM	0.92 - 1.19	1.04 - 1.07	35.42 - 151.22	1.75 - 2.15
High compliance - IM	0.87 - 1.29	1.05 - 1.14	29.93 - 68.09	2.67 - 3.84
Low Compliance - IM	0.93 - 1.07	1.09 - 1.15	18.16 - 71.75	1.77 - 1.93
Flexible fisher behaviour - IM	0.97 - 1.23	1.06 - 1.14	27.03 - 46.23	1.56 - 2.01
Increased fishing pressure drivers - IM	0.88 - 1.28	1.08 - 1.2	150.27 - 333.22	1.53 - 2.13
High Cost, Low Values - IM	0.91 - 1.32	1.05 - 1.07	36.76 - 56.5	1.73 - 2.14
Low Costs, High Values - IM	0.88 - 3.04	1.05 - 1.15	11.68 - 39.96	2.04 - 3.38
Standard Markets - IM	0.92 - 2.24	1.06 - 1.12	16.92 - 78.41	1.86 - 2.2
Technology Creep - IM	1.09 - 3.37	1.05 - 1.13	42.36 - 77.18	1.87 - 2.24
No Acclimation - 2010 coastal context - IM	1.11 - 1.12	1.05 - 1.13	3.37 - 77.48	2.63 - 4.17
No Acclimation - Cumulative impacts - SQ	1.11 - 1.58	1.05 - 1.12	9.06 - 12.8	3.13 - 4.12

Table 39: Range of relative aquaculture production (in 2065-2070) in Atlantis-SEAP under RCP 4.5.

Scenario	Aquaculture Salmon	Aquaculture Tuna	Aquaculture Oysters Mussels and Abalone	Aquaculture Prawns
No Climate change - 2010 context - SQ	1.06 - 1.28	1.1 - 1.17	30.12 - 971.43	1.11 - 2.02
2010 coastal context - Cap ecosystem take	0.67 - 0.85	1.02 - 1.18	48.38 - 1765.81	2.23 - 3.72
2010 coastal context - Centralised mgmt.	0.64 - 3.1	1.03 - 1.14	303.91 - 818.48	1.62 - 2.19
2010 coastal context - FewMPA	0.61 - 1.05	1 - 1.1	81.12 - 648.85	1.46 - 2.17
2010 coastal context - Fragmented mgmt	0.6 - 1.42	0.99 - 1.13	28.81 - 468.89	1.54 - 2.19
2010 coastal context - ManyMPA	0.71 - 2.51	1.07 - 1.12	266.77 - 960.31	1.74 - 2.27
2010 coastal context - Seasons	0.62 - 0.88	0.99 - 1.08	364.46 - 1232.42	1.44 - 1.57
2010 coastal context - SlowAssess	0.69 - 1.91	1.06 - 1.12	52.15 - 150.45	3.79 - 6.06
2010 coastal context - Integrated Mgmt (IM)	0.8 - 3.05	1.03 - 1.12	263.49 - 17675.36	1.52 - 2.65
Cumulative impacts - 2010 Status Quo (SQ)	0.61 - 1.29	0.98 - 1.14	195.59 - 5385.59	1.66 - 2.64
Cumulative impacts - Cap ecosystem take	0.5 - 1.36	0.99 - 1.11	1817.7 - 6153.42	1.12 - 1.23
Cumulative impacts - Centralised mgmt.	0.52 - 0.79	0.99 - 1.04	1818.48 - 6188.95	1.09 - 1.1
Cumulative impacts - FewMPA	0.54 - 0.62	0.98 - 1.15	801.09 - 4827.4	1.1 - 1.22
Cumulative impacts - Fragmented mgmt	0.59 - 0.78	1.01 - 1.07	774.58 - 5028.34	1.11 - 1.13
Cumulative impacts - ManyMPA	0.52 - 1.76	1.07 - 1.12	532.34 - 5757.17	1.08 - 1.22
Cumulative impacts - Seasons	0.53 - 1.26	1.01 - 1.12	811.76 - 6438.98	0.95 - 1.05
Cumulative impacts - SlowAssess	0.48 - 0.72	1.07 - 1.14	526.34 - 650.99	1.29 - 1.68
Cumulative impacts - IM	0.52 - 0.79	1.03 - 1.13	104.63 - 1126.53	1.14 - 1.36
Expanded LTL fishery - IM	0.6 - 1.68	0.98 - 1.16	196.09 - 4232.36	1.18 - 1.4
New mesopelgic fishery - IM	0.77 - 1.36	1.07 - 1.16	161.21 - 773.15	1.87 - 2.29
Extreme climate events - IM	0.76 - 1	1.01 - 1.13	271.27 - 613.66	2.6 - 3.39
Blooms - IM	0.7 - 1.46	1.02 - 1.13	293.71 - 671.42	2.44 - 3.11
Primary production regime shift - IM	0.73 - 1.62	0.98 - 1.03	182.86 - 670.42	2.29 - 3.01
Fish kills - IM	0.72 - 1.57	1 - 1.12	277.98 - 878.22	2.32 - 3.65
Range extensions - IM	0.79 - 1.59	1.05 - 1.06	303 - 1274.6	2.2 - 3.61
Gear switching allowed - IM	0.7 - 1.92	0.98 - 1.09	61.21 - 1004.81	1.88 - 2.34
High compliance - IM	0.85 - 1.24	0.99 - 1.03	79.48 - 600.69	2.62 - 3.74
Low Compliance - IM	0.67 - 1.08	1.01 - 1.02	18.36 - 1126.06	1.66 - 2.13
Flexible fisher behaviour - IM	0.85 - 1.21	1.01 - 1.06	81.39 - 803.7	1.52 - 2.06
Increased fishing pressure drivers - IM	0.69 - 1.06	1 - 1.03	1495.17 - 5957.77	1.57 - 2.26
High Cost, Low Values - IM	0.74 - 2.74	1.06 - 1.14	249.26 - 564.34	1.62 - 2.17
Low Costs, High Values - IM	0.62 - 2.1	1.08 - 1.16	410.37 - 452.72	2.07 - 3.6
Standard Markets - IM	0.97 - 2.05	0.99 - 1.11	567.46 - 1112.31	1.8 - 2.29
Technology Creep - IM	0.7 - 2.95	1.02 - 1.1	270.98 - 348.1	1.83 - 2.24
No Acclimation - 2010 coastal context - IM	0.68 - 1.9	0.99 - 1.14	16.21 - 346.02	3.15 - 4.74
No Acclimation - Cumulative impacts - SQ	0.64 - 1.28	1.04 - 1.11	10.73 - 33.92	3.1 - 4.3

Table 40: Range of relative aquaculture production (in 2065-2070) in Atlantis-SEAP under RCP 8.5.

Scenario	Aquaculture Salmon	Aquaculture Tuna	Aquaculture Oysters Mussels and Abalone	Aquaculture Prawns
No Climate change - 2010 context - SQ	1.06 - 1.28	1.1 - 1.17	30.12 - 971.43	1.11 - 2.02
2010 coastal context - Cap ecosystem take	0.2 - 0.82	0.95 - 1.04	19.93 - 195.28	1.32 - 3.2
2010 coastal context - Centralised mgmt.	0.31 - 0.59	0.96 - 1.08	406.01 - 511.59	1.85 - 1.95
2010 coastal context - FewMPA	0.24 - 0.48	0.94 - 1.14	300.27 - 477.27	1.67 - 2.02
2010 coastal context - Fragmented mgmt	0.34 - 0.45	1.03 - 1.17	205.16 - 297.98	1.81 - 1.98
2010 coastal context - ManyMPA	0.24 - 1.09	0.95 - 1	253.18 - 350.12	2.04 - 2.21
2010 coastal context - Seasons	0.31 - 1.13	0.96 - 1.16	369.99 - 460.61	1.04 - 1.18
2010 coastal context - SlowAssess	0.31 - 1.63	1.02 - 1.07	87.4 - 170.04	1.92 - 1.99
2010 coastal context - Integrated Mgmt (IM)	0.22 - 1.85	1.1 - 1.13	430.84 - 20133.9	1.89 - 2.29
Cumulative impacts - 2010 Status Quo (SQ)	0.1 - 0.44	0.97 - 1.18	153.48 - 6404.23	1.73 - 2.37
Cumulative impacts - Cap ecosystem take	0.34 - 0.96	0.95 - 1.17	2834.66 - 5398.17	1 - 1.04
Cumulative impacts - Centralised mgmt.	0.36 - 0.94	0.97 - 1.14	3018.23 - 5400.5	1 - 1.04
Cumulative impacts - FewMPA	0.07 - 1.55	0.97 - 1.09	4823.97 - 5551.51	1.02 - 1.08
Cumulative impacts - Fragmented mgmt	0.08 - 0.36	1.09 - 1.15	2505.18 - 3293.94	1 - 1.02
Cumulative impacts - ManyMPA	0.43 - 0.71	1.1 - 1.16	3590.57 - 4018.13	1.04 - 1.08
Cumulative impacts - Seasons	0.25 - 0.45	0.97 - 1.03	5242.65 - 6043.48	0.97 - 1.05
Cumulative impacts - SlowAssess	0.15 - 0.62	0.94 - 1.07	1319.77 - 1911.94	1.12 - 1.18
Cumulative impacts - IM	0.14 - 1.05	0.94 - 1.03	208.23 - 5360.09	1.06 - 1.16
Expanded LTL fishery - IM	0.52 - 2	0.93 - 0.98	257.13 - 5155.35	1.01 - 1.17
New mesopelgic fishery - IM	0.24 - 0.47	0.98 - 1.06	365.9 - 451.68	1.99 - 2.18
Extreme climate events - IM	0.3 - 0.44	0.94 - 1.12	395.6 - 592.57	1.42 - 1.49
Blooms - IM	0.42 - 0.64	0.95 - 1.15	446.9 - 636.15	1.48 - 2.7
Primary production regime shift - IM	0.28 - 0.58	1.01 - 1.09	412.34 - 595.58	2.56 - 2.76
Fish kills - IM	0.21 - 0.57	0.96 - 1.09	385.79 - 1587.04	1.5 - 2.3
Range extensions - IM	0.42 - 0.49	0.98 - 1.05	412.1 - 640.81	1.51 - 2.71
Gear switching allowed - IM	0.33 - 0.53	0.94 - 1.06	409.61 - 1594.38	1.9 - 2.04
High compliance - IM	0.33 - 0.54	1.03 - 1.16	222.54 - 255.72	1.51 - 1.65
Low Compliance - IM	0.35 - 0.72	0.94 - 1.17	284.21 - 389.38	1.7 - 1.91
Flexible fisher behaviour - IM	0.2 - 0.78	0.99 - 1.08	281.98 - 480.26	1.72 - 1.92
Increased fishing pressure drivers - IM	0.23 - 0.62	0.96 - 1.02	3195.83 - 3614.12	1.72 - 1.89
High Cost, Low Values - IM	0.2 - 0.93	0.96 - 1.11	399.04 - 497.37	1.82 - 1.99
Low Costs, High Values - IM	0.38 - 0.81	0.94 - 1.15	257.4 - 349.32	1.46 - 2.69
Standard Markets - IM	0.53 - 1.56	0.99 - 1.16	329.87 - 506.73	1.92 - 2.21
Technology Creep - IM	0.29 - 0.5	0.96 - 1.16	304.38 - 500.18	1.96 - 2.23
No Acclimation - 2010 coastal context - IM	0.15 - 0.32	1.05 - 1.15	5.35 - 747.01	1.4 - 1.88
No Acclimation - Cumulative impacts - SQ	0.07 - 0.79	0.95 - 1.14	5.19 - 10.03	1.61 - 1.77

PROFIT

Under RCP 3 and 4.5 invertebrate GVPUE increases (Tables 41-42), decreases for forage fish (except when mesopelagics are fished). The results for the overall GVPUE and for finfish and sharks are mixed and dependent on the parameterisation. Under low productivity parameterisations, GVPUE for these groups can decline under cumulative impacts, when there are regime shifts in productivity or when costs are low, technological efficiency increases or regulatory control is weaker (when there is little spatial management, reliance on seasonal closures or when compliance is low). Under high productivity parameterisations GVPUE can increase across all strategies and scenarios for all the taxonomic classes so long as acclimation occurs. Under RCP 8.5 (Table 43) GVPUE for finfish increases under all strategies and scenarios, whereas overall GVPUE for forage fish, sharks and invertebrates declines under cumulative impacts or when there is no acclimation (either under all parameterisations or at least under the lower productivity parameterisations).

There was no formal modelling of the quota market in Atlantis-SEAP. Instead it is assumed the quota market is efficient enough that all fishers can access sufficient quota to meet their needs.

VESSEL SIZES AND EMPLOYMENT

As with Atlantis-SE there is a general increase in boat size as fleets contract in size, with smaller boats lost from the system, especially under RCP 8.5. Much of the increase in effort is via the current sized vessels increasing their activity, however many of the new vessels used in the new fisheries are at the larger end of the scale (e.g. in the krill and jellyfish fisheries). Increases in vessel size are much smaller for the other RCPs, though the average size of vessels still grows.

Employment levels are dictated by the gear type and the size of the fleets and vessels. In general employment increases under the higher productivity parameterisations of all emission scenarios and management strategies (Tables 44). However, under the low productivity parameterisations employment falls under many of the management strategies and scenarios for RCP 3 – except when there is little spatial management, expanded forage fish fisheries, regime shifts in productivity, extreme events, gear switching and higher fishing pressure and lower compliance. Interestingly employment can also increase if there are higher costs and compliance – due to expanded trawl fisheries for invertebrates and employment in new fisheries (e.g. kelp collection and microalgal biofuels). Under RCP 4.5 employment increases in most cases and for most parameterisations when there are no cumulative impacts – employment falls for low productivity parameterisations. Under RCP 8.5 there is a completely different pattern of employment shifts. In most cases employment holds steady or declines. The main exceptions occur when there are cumulative impacts or no acclimation, when employment grows consistently due to the contributions by new fisheries (including for urchins), cephalopod and tuna fisheries. The later is unlikely to be due to new jobs, just ones relocated due to the shifting distribution of the species. There is also a growth in employment under RCP 8.5 when there are fish kills or increased fishing activity, low costs or reduced regulatory constraints. As with the other emission scenarios it is possible to see modest employment increases if there are higher costs and compliance. In all of these cases the growth in employment comes from new fisheries (including for urchins), or the cephalopod and tuna fisheries.

TRADEOFFS

Once again the no acclimation cases sit separately to the other cases in multidimensional space (Figures 61-64). Unlike Atlantis-SE, the simulations under RCP 3 sit within a broader cluster of RCP 8 scenarios and strategies; the RCP 4.5 cases are clearly distinct however. In this instance, the first principal component is defined by LFI and biodiversity on the one extreme and by macroinvertebrates, primary production and the status of demersal fish, threatened endangered and protected species on the other end. This axis differentiates RCP 4.5 from the other emission scenarios. The second principal component is aligned with overall stock status and GVPUE at one end and Effort and Employment at the other. This axis distinguishes the no acclimation cases from the other simulations; and cumulative impacts from other cases within each emissions scenario.

When emissions scenarios are considered one at a time the cumulative impacts cases sit separate to the rest but in a large loose cluster (Figures 62-64). Under RCP 3 and 4.5 the case where there was little spatial management also sits within this loose cluster. The other management strategies and scenarios tend to cluster more tightly together, although under RCP 2 and 4.5 it is possible to see that the cases where there is improved stocks status for traditional target species group a little separately.

As was the case for Atlantis-SE there is little point in presenting trade-off plots for every combination of parameterisation, scenario and strategy and so clustering from the multidimensional analyses was used to

Table 41: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SEAP under RCP 3

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	0.97 - 1.49	2.26 - 3.91	0.41 - 1.24	0.97 - 2.32	1.16 - 2.69
2010 coastal context - Cap ecosystem take	1.57 - 2.11	1.76 - 5.57	0.2 - 3.22	6.05 - 12.29	1.8 - 2.45
2010 coastal context - Centralised mgmt.	1.7 - 1.94	1.7 - 5.28	0.19 - 3.23	5.97 - 10.37	1.86 - 3.24
2010 coastal context - FewMPA	0.12 - 4.22	0.48 - 2.26	0.27 - 5.41	0.2 - 32.73	1.65 - 2.14
2010 coastal context - Fragmented mgmt	1.42 - 2.01	1.55 - 6.05	0.2 - 3.21	3.76 - 9.34	2.49 - 3.49
2010 coastal context - ManyMPA	1.99 - 13.24	3.06 - 7.56	0.43 - 5.67	1.78 - 188.58	2.94 - 3.98
2010 coastal context - Seasons	0.2 - 1.8	0.73 - 4.62	0.23 - 3.79	0.17 - 6.49	3.48 - 4.74
2010 coastal context - SlowAssess	1.22 - 1.6	1.33 - 4.13	0.05 - 3.21	2.63 - 3.18	1.61 - 4.87
2010 coastal context - Integrated Mgmt (IM)	0.97 - 1.41	1.78 - 4.82	0.05 - 3.22	0.43 - 1.9	1.98 - 2.51
Cumulative impacts - 2010 Status Quo (SQ)	0.6 - 1.11	0.51 - 2.8	0.05 - 1.8	0.84 - 2.01	1.36 - 2.82
Cumulative impacts - Cap ecosystem take	0.81 - 1.07	0.61 - 3.03	0.05 - 1.8	0.85 - 1.28	1.33 - 2.34
Cumulative impacts - Centralised mgmt.	0.84 - 1.24	0.56 - 2.18	0.05 - 1.8	0.77 - 1.45	1.34 - 2.99
Cumulative impacts - FewMPA	0.02 - 0.8	0.18 - 1.71	0.06 - 3.02	0.02 - 1.7	0.9 - 5.01
Cumulative impacts - Fragmented mgmt	0.87 - 1.44	0.56 - 3.07	0.05 - 1.8	0.71 - 3.89	1.35 - 4.39
Cumulative impacts - ManyMPA	0.94 - 2.82	1.18 - 3.32	0.1 - 3.16	0.44 - 8.76	1.57 - 6.04
Cumulative impacts - Seasons	0.05 - 1.31	0.4 - 2.96	0.05 - 2.12	0.04 - 3.04	1.97 - 3.55
Cumulative impacts - SlowAssess	1.34 - 4.53	0.45 - 3.82	0.2 - 1.8	2.42 - 35.28	1.61 - 3.47
Cumulative impacts - IM	0.99 - 1.05	0.77 - 5.54	0.2 - 1.8	1.23 - 2.35	1.24 - 3.03
Expanded LTL fishery - IM	1.51 - 1.86	1.79 - 5.74	0.19 - 3.22	3.84 - 8.47	2.38 - 4.87
New mesopelgic fishery - IM	2.01 - 2.68	1.09 - 6.58	3.1 - 7.04	6.65 - 11.27	1.98 - 3.52
Extreme climate events - IM	1.43 - 9.57	1 - 5.74	0.21 - 3.53	4.83 - 82.14	1.85 - 3.83
Blooms - IM	1.41 - 6.13	0.66 - 5.54	0.21 - 3.5	3.83 - 49.98	1.94 - 3.36
Primary production regime shift - IM	0.31 - 9.1	0.69 - 6.1	0.21 - 3.65	0.54 - 77.74	1.95 - 3.63
Fish kills - IM	1.33 - 8.87	0.67 - 6.02	0.21 - 3.53	3.34 - 82.08	2.59 - 4.58
Range extensions - IM	1.3 - 8.37	1.43 - 5.44	0.2 - 3.22	3.76 - 68.38	2.4 - 4.08
Gear switching allowed - IM	0.26 - 2.91	1.19 - 3.13	0.18 - 3.05	0.43 - 20.92	2.13 - 3.07
High compliance - IM	0.59 - 2.02	1.89 - 6.3	0.19 - 3.23	0.5 - 11.58	2.29 - 4.09
Low Compliance - IM	1.84 - 4.41	1.62 - 4.36	0.19 - 3.21	7.46 - 31.52	1.82 - 5.63
Flexible fisher behaviour - IM	0.74 - 1.02	2.58 - 6.03	0.17 - 2.98	0.61 - 3.7	0.8 - 1.41
Increased fishing pressure drivers - IM	1.3 - 3.1	1.75 - 6.25	0.2 - 3.22	1.9 - 12.29	2.25 - 9.18
High Cost, Low Values - IM	0.11 - 322	0.04 - 2.84	0.17 - 2.94	0.03 - 2.38	2.24 - 2039.1
Low Costs, High Values - IM	0.2 - 1.91	2.05 - 6.55	0.19 - 3.27	0.15 - 8.8	2.27 - 4.86
Standard Markets - IM	1.36 - 2.41	1.37 - 5.44	0.19 - 3.23	2.25 - 13.95	2.51 - 3.84
Technology Creep - IM	0.38 - 4.95	0.22 - 8.53	0.36 - 6.14	0.49 - 37.46	2.39 - 3.46
No Acclimation - 2010 coastal context - IM	0.23 - 0.54	0.06 - 0.53	0.01 - 0.01	0.31 - 2.26	0.37 - 0.68
No Acclimation - Cumulative impacts - SQ	0.49 - 0.77	0.07 - 0.34	0 - 0.01	0.32 - 6.74	0.35 - 0.72

Table 42: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SEAP under RCP 4.5

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	0.97 - 1.49	2.26 - 3.91	0.41 - 1.24	0.97 - 2.32	1.16 - 2.69
2010 coastal context - Cap ecosystem take	1.63 - 4.13	2.08 - 6.36	0.28 - 3.22	6.76 - 53.17	1.96 - 26.82
2010 coastal context - Centralised mgmt.	1.88 - 4.97	2.28 - 5.36	0.22 - 3.22	8.8 - 27.47	2.02 - 49.45
2010 coastal context - FewMPA	0.14 - 4.75	0.76 - 2.31	0.34 - 5.39	0.19 - 37.05	1.84 - 21.07
2010 coastal context - Fragmented mgmt	1.77 - 3.62	1.76 - 8.32	0.27 - 3.21	6.38 - 35.24	2.03 - 26.68
2010 coastal context - ManyMPA	2.21 - 14.93	3.26 - 8.12	0.42 - 5.66	2.96 - 211.4	2.34 - 39.86
2010 coastal context - Seasons	0.95 - 5.98	1.12 - 5.35	0.35 - 3.79	0.37 - 7.32	4.22 - 190.49
2010 coastal context - SlowAssess	2.77 - 13.64	1.27 - 4.76	0.06 - 3.21	2.98 - 14.6	21.61 - 39.7
2010 coastal context - Integrated Mgmt (IM)	1.36 - 5.22	2.08 - 5.57	0.08 - 3.22	0.43 - 53.17	1.91 - 27.18
Cumulative impacts - 2010 Status Quo (SQ)	0.6 - 3.05	0.55 - 5.36	0.06 - 1.81	0.81 - 9.71	1.46 - 23.91
Cumulative impacts - Cap ecosystem take	0.79 - 2.29	0.66 - 4.98	0.06 - 1.8	0.92 - 6.49	1.43 - 17.93
Cumulative impacts - Centralised mgmt.	0.82 - 3.42	0.6 - 4.16	0.05 - 1.81	0.83 - 29.31	1.43 - 18.6
Cumulative impacts - FewMPA	0.02 - 0.87	0.24 - 1.83	0.08 - 3.02	0.01 - 1.85	0.95 - 17.55
Cumulative impacts - Fragmented mgmt	0.87 - 2.19	0.6 - 5	0.06 - 1.8	0.77 - 4.08	1.45 - 18.71
Cumulative impacts - ManyMPA	0.93 - 3.42	1.26 - 4.73	0.16 - 3.16	0.43 - 9.57	1.67 - 36.6
Cumulative impacts - Seasons	0.04 - 1.43	0.42 - 2.96	0.07 - 2.12	0.04 - 3.2	2.1 - 26.13
Cumulative impacts - SlowAssess	1.44 - 5.15	0.49 - 4.89	0.23 - 1.8	6.35 - 40.81	1.76 - 18.52
Cumulative impacts - IM	1 - 2.14	0.83 - 8.69	0.24 - 1.8	2.25 - 6.49	1.35 - 12.58
Expanded LTL fishery - IM	1.62 - 2.97	1.99 - 6.19	0.22 - 3.21	5.01 - 19.12	2.59 - 27.15
New mesopelgic fishery - IM	1.6 - 171.04	1.5 - 6.26	2.17 - 995.21	6.55 - 30.93	2.14 - 26.65
Extreme climate events - IM	1.44 - 2.98	0.89 - 7.14	0.26 - 3.55	6.28 - 21.62	2.01 - 26.93
Blooms - IM	1.45 - 7.06	0.7 - 6.82	0.26 - 3.51	5.64 - 58.04	2.11 - 27.03
Primary production regime shift - IM	0.98 - 2.39	1.04 - 7.6	0.26 - 3.67	2.49 - 18.32	2.12 - 13.8
Fish kills - IM	2.03 - 2.74	0.78 - 6.78	0.26 - 3.54	10.18 - 14.29	2.56 - 27.51
Range extensions - IM	1.95 - 4.31	1.81 - 7.52	0.26 - 3.22	8.22 - 39.98	2.05 - 26.94
Gear switching allowed - IM	0.3 - 3.25	0.26 - 3.71	0.22 - 3.04	0.59 - 24.12	2.61 - 24.17
High compliance - IM	2.24 - 2.92	2.16 - 7.92	0.22 - 3.22	13.34 - 18.52	2.42 - 27.47
Low Compliance - IM	1.76 - 4.66	2 - 6.35	0.23 - 3.21	5.46 - 36.56	1.98 - 26.82
Flexible fisher behaviour - IM	0.95 - 2.7	2.85 - 6.95	0.19 - 2.98	3.35 - 15.24	0.86 - 10.26
Increased fishing pressure drivers - IM	1.77 - 4.13	2.07 - 7.73	0.28 - 3.22	6.76 - 53.17	2.4 - 26.82
High Cost, Low Values - IM	0.11 - 0.98	0.04 - 3.22	0.22 - 2.93	0.22 - 2.63	2.45 - 21.56
Low Costs, High Values - IM	1.43 - 2	2.38 - 8.53	0.24 - 3.27	4.97 - 10.12	2.46 - 27.07
Standard Markets - IM	1.37 - 2.63	1.64 - 7.05	0.26 - 3.22	3.6 - 16.08	2.05 - 26.96
Technology Creep - IM	0.38 - 5.68	0.24 - 10.5	0.46 - 6.14	0.97 - 43.3	2.62 - 26.79
No Acclimation - 2010 coastal context - IM	0.25 - 0.95	0.08 - 0.86	0 - 0.01	0.93 - 1.35	0.36 - 2.06
No Acclimation - Cumulative impacts - SQ	0.74 - 1.2	0.08 - 0.4	0 - 0.01	1.44 - 6.25	0.38 - 2.35

Table 43: Range of relative gross value per unit effort (GVPUE) in 2065-2070 in total and per major product type in Atlantis-SEAP under RCP 8.5

Scenario	GVPUE-Tot	GVPUE-Fish	GVPUE-LTL	GVPUE-Shark	GVPUE-Invert
No Climate change - 2010 context - SQ	0.97 - 1.49	2.26 - 3.91	0.41 - 1.24	0.97 - 2.32	1.16 - 2.69
2010 coastal context - Cap ecosystem take	4.28 - 8.45	18.98 - 104.42	1.98 - 3.01	5.92 - 16.22	1.51 - 4.91
2010 coastal context - Centralised mgmt.	4.72 - 31.88	22.6 - 92.47	1.97 - 3.01	3.74 - 123.49	1.42 - 90.08
2010 coastal context - FewMPA	3.59 - 10.24	12.38 - 51	2.67 - 4.5	2.41 - 41.21	1 - 4.69
2010 coastal context - Fragmented mgmt	5.35 - 17.9	22.11 - 119.46	1.96 - 3.21	4.95 - 110.91	1.62 - 3.84
2010 coastal context - ManyMPA	6.85 - 29.22	24.96 - 213.14	4.27 - 6.73	5.96 - 233.83	2.11 - 4.34
2010 coastal context - Seasons	2 - 117.52	2.81 - 25.2	2.37 - 4.69	1.98 - 37.66	3.46 - 356.2
2010 coastal context - SlowAssess	5.84 - 39.24	8.67 - 32.1	1.28 - 1.98	1.91 - 9.45	2.75 - 231.48
2010 coastal context - Integrated Mgmt (IM)	2.49 - 5.83	10.26 - 37.62	1.29 - 1.98	1.92 - 5.21	1.84 - 4.45
Cumulative impacts - 2010 Status Quo (SQ)	0.79 - 11.6	11.76 - 25.54	0.16 - 0.54	0.65 - 0.81	0.33 - 53.3
Cumulative impacts - Cap ecosystem take	0.85 - 3.62	11.38 - 25.6	0.16 - 0.56	0.3 - 2.69	0.35 - 15.77
Cumulative impacts - Centralised mgmt.	0.85 - 1.22	14.21 - 25.84	0.17 - 0.55	1.05 - 2.15	0.33 - 2.23
Cumulative impacts - FewMPA	0.67 - 1.01	7.97 - 13.12	0.14 - 0.45	0.45 - 1.37	0.21 - 1.73
Cumulative impacts - Fragmented mgmt	0.8 - 6.14	13.14 - 25.19	0.17 - 0.53	0.65 - 2.11	0.37 - 28.02
Cumulative impacts - ManyMPA	1.21 - 17.79	15.94 - 27.76	0.43 - 1.01	1.15 - 1.89	0.37 - 53.06
Cumulative impacts - Seasons	0.37 - 0.44	1.05 - 3.49	0.2 - 0.61	0.33 - 1.14	0.4 - 0.94
Cumulative impacts - SlowAssess	1.15 - 2.12	19.33 - 72.67	0.25 - 1.1	0.97 - 12.65	0.33 - 0.47
Cumulative impacts - IM	1.17 - 1.46	22.23 - 90.8	0.26 - 1.09	0.79 - 3.36	0.26 - 0.33
Expanded LTL fishery - IM	5.2 - 14.99	24.69 - 93.45	1.95 - 3.01	9.14 - 100.71	2.16 - 4.22
New mesopelgic fishery - IM	2.21 - 3.88	2.07 - 7.31	4.7 - 8.56	3.83 - 17.47	1.44 - 3.52
Extreme climate events - IM	1.95 - 12.23	1.76 - 12.48	2.63 - 4.25	8.4 - 101.33	1.53 - 3.47
Blooms - IM	1.97 - 8.15	1.79 - 12.63	2.65 - 4.25	6.29 - 61.95	1.6 - 3.57
Primary production regime shift - IM	1.83 - 11.7	1.65 - 13.24	2.65 - 4.25	8.44 - 95.9	1.61 - 3.4
Fish kills - IM	1.66 - 11.36	1.4 - 12.62	2.64 - 4.25	5.54 - 101.26	1.85 - 4.16
Range extensions - IM	4.97 - 15.22	22.58 - 104.39	1.99 - 3.01	4.09 - 84.98	1.69 - 4.68
Gear switching allowed - IM	5.44 - 8.03	17.04 - 75.16	1.61 - 2.59	9.05 - 29.84	1.39 - 2.92
High compliance - IM	3.76 - 18.66	22.06 - 129.7	1.97 - 3.01	6.81 - 138.46	1.79 - 4.14
Low Compliance - IM	5.21 - 9.85	22.24 - 136.84	2 - 3.08	4.47 - 39.6	1.51 - 3.5
Flexible fisher behaviour - IM	3.68 - 10.02	47.21 - 188.12	1.5 - 1.89	2.28 - 41.9	0.65 - 1.64
Increased fishing pressure drivers - IM	4.58 - 21.74	18.98 - 104.42	1.98 - 3.01	5.92 - 147.09	2.33 - 4.31
High Cost, Low Values - IM	3.33 - 43.18	11.66 - 64.23	1.68 - 2.48	1.37 - 8.47	1.43 - 242.96
Low Costs, High Values - IM	4.26 - 8.06	20.23 - 109.98	2.01 - 3.05	6.51 - 14.91	1.95 - 5.74
Standard Markets - IM	5.26 - 8.02	20.58 - 103.3	1.98 - 3.03	7.53 - 24.71	1.63 - 3.47
Technology Creep - IM	9.27 - 15.42	59.09 - 245.12	3.02 - 3.71	8.27 - 46.66	1.65 - 3.76
No Acclimation - 2010 coastal context - IM	0.74 - 1.07	1.52 - 28.16	0.01 - 0.01	1.04 - 9.85	0.37 - 0.58
No Acclimation - Cumulative impacts - SQ	1.81 - 57.36	1.35 - 14.33	0.01 - 0.01	0.88 - 50.96	0.35 - 257.15

Table 44: Range of relative total employment in 2065-2070 (in 2065-2070) in Atlantis-SEAP under the different emission scenarios

Scenario	RCP 3	RCP 4.5	RCP 8.5
No Climate change - 2010 context - SQ	0.98 - 1.51	0.98 - 1.51	0.98 - 1.51
2010 coastal context - Cap ecosystem take	0.84 - 1.1	1.09 - 2.73	0.71 - 1.06
2010 coastal context - Centralised mgmt.	0.8 - 1.11	1.11 - 2.69	0.65 - 1.11
2010 coastal context - FewMPA	1.5 - 13.73	1.61 - 14.67	1.01 - 1.5
2010 coastal context - Fragmented mgmt	0.93 - 1.11	1.11 - 2.81	0.66 - 1.05
2010 coastal context - ManyMPA	0.59 - 1.22	0.62 - 2.58	0.56 - 0.59
2010 coastal context - Seasons	0.7 - 6.23	0.75 - 7.85	0.59 - 0.69
2010 coastal context - SlowAssess	0.82 - 1.3	1.09 - 2.7	0.61 - 1.06
2010 coastal context - Integrated Mgmt (IM)	0.81 - 1.05	1.04 - 2.12	0.66 - 1.04
Cumulative impacts - 2010 Status Quo (SQ)	0.7 - 1.19	0.81 - 1.82	10.16 - 13
Cumulative impacts - Cap ecosystem take	0.73 - 1.13	0.79 - 1.85	9.4 - 12.48
Cumulative impacts - Centralised mgmt.	0.69 - 1.16	0.81 - 1.81	9.84 - 12.55
Cumulative impacts - FewMPA	1 - 29.34	1.12 - 31.65	13.55 - 18.99
Cumulative impacts - Fragmented mgmt	0.82 - 1.17	0.91 - 1.95	10 - 12.7
Cumulative impacts - ManyMPA	0.51 - 1.4	0.54 - 1.73	8.69 - 15.09
Cumulative impacts - Seasons	0.61 - 14.43	0.66 - 15.51	6.5 - 8.75
Cumulative impacts - SlowAssess	0.71 - 1.51	0.86 - 1.83	9.89 - 12.52
Cumulative impacts - IM	0.71 - 1.12	0.82 - 1.49	9.38 - 12.46
Expanded LTL fishery - IM	1.35 - 2.52	2.4 - 3.24	1.24 - 2.38
New mesopelgic fishery - IM	0.97 - 1.57	1.41 - 2.86	0.84 - 1.38
Extreme climate events - IM	0.81 - 1.14	1.12 - 2.7	0.69 - 1.09
Blooms - IM	0.79 - 1.08	1.08 - 2.67	0.67 - 1.08
Primary production regime shift - IM	1.08 - 5.38	1.12 - 6.06	0.66 - 1.09
Fish kills - IM	1.3 - 2.35	2.29 - 3.18	1.3 - 2.36
Range extensions - IM	1.06 - 1.12	1.07 - 2.94	0.66 - 1.13
Gear switching allowed - IM	1.21 - 6.8	1.25 - 29.52	1.04 - 1.24
High compliance - IM	2.19 - 2.74	2.23 - 4.6	1.32 - 2.2
Low Compliance - IM	0.78 - 1.09	0.88 - 2.66	0.7 - 0.85
Flexible fisher behaviour - IM	1.42 - 2.04	1.42 - 3.76	0.99 - 2.05
Increased fishing pressure drivers - IM	0.84 - 1.1	1.1 - 2.73	0.71 - 1.1
High Cost, Low Values - IM	2.98 - 174.46	3.08 - 168.22	1.98 - 3.07
Low Costs, High Values - IM	2.39 - 7.62	2.4 - 9.39	1.39 - 2.39
Standard Markets - IM	0.84 - 1.12	1.12 - 2.72	0.7 - 1.09
Technology Creep - IM	1.11 - 39.7	1.15 - 38.53	0.79 - 1.12
No Acclimation - 2010 coastal context - IM	16.46 - 35.78	15.81 - 35.34	10.75 - 36.97
No Acclimation - Cumulative impacts - SQ	19.57 - 34.21	19.61 - 33.79	12.7 - 35.43

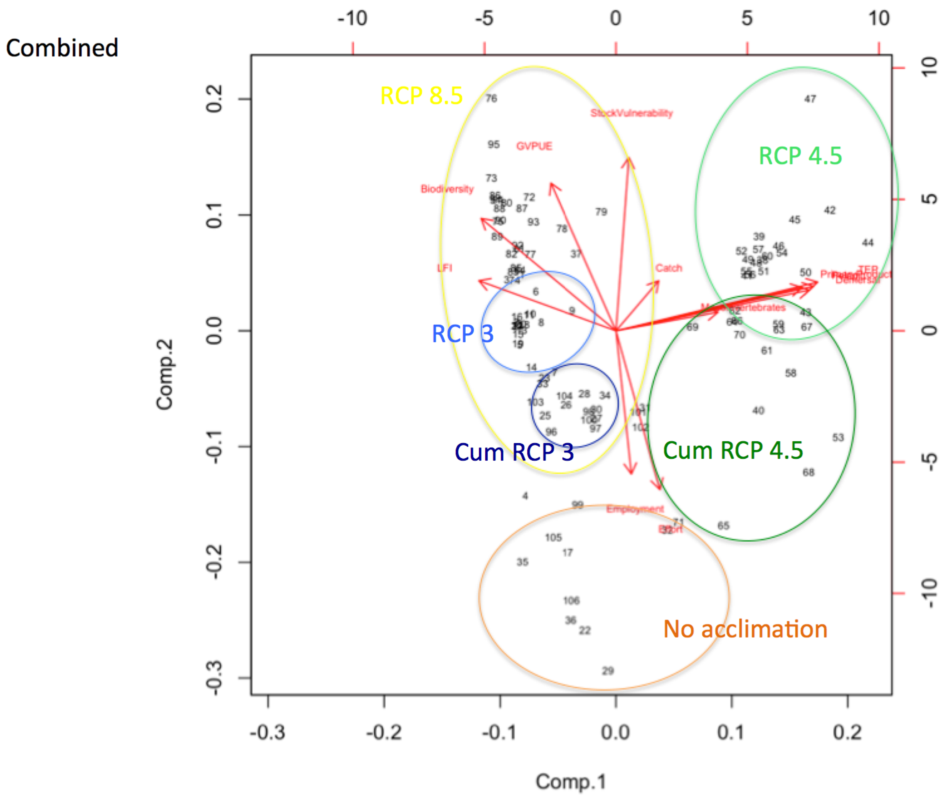


Figure 61: PCA biplot for complete set of Atlantis-SEAP strategies and scenarios. Small numbers are IDs for individual strategy-scenario combinations.

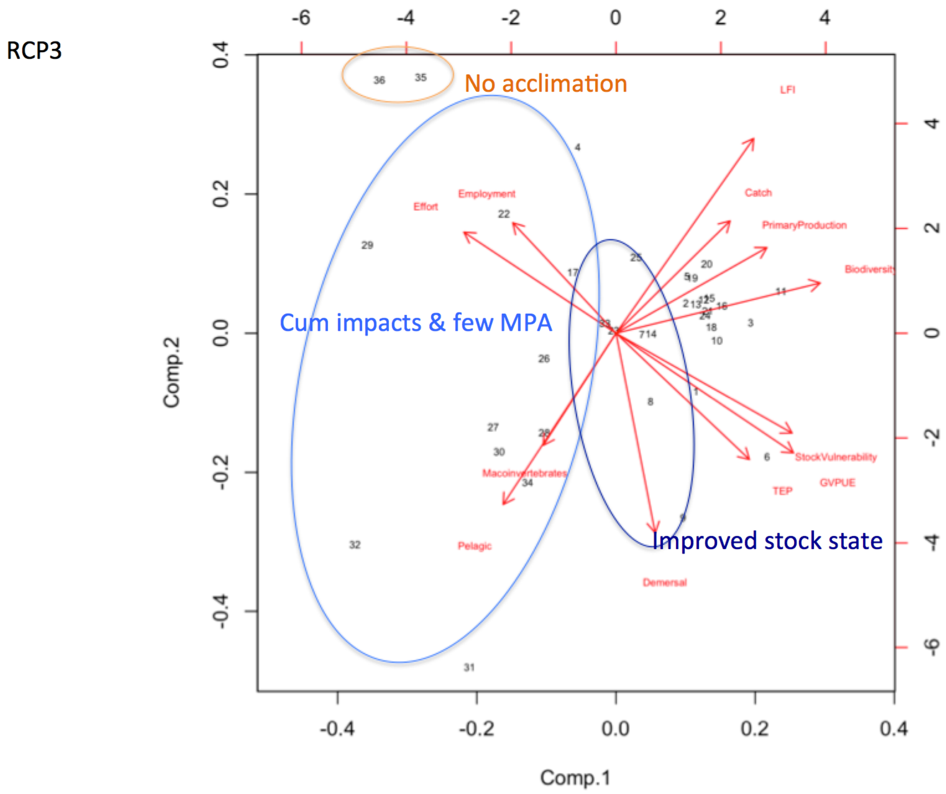


Figure 62: PCA biplot for Atlantis-SEAP simulations strategies and scenarios under RCP 3. Small numbers are IDs for individual strategy-scenario combinations.

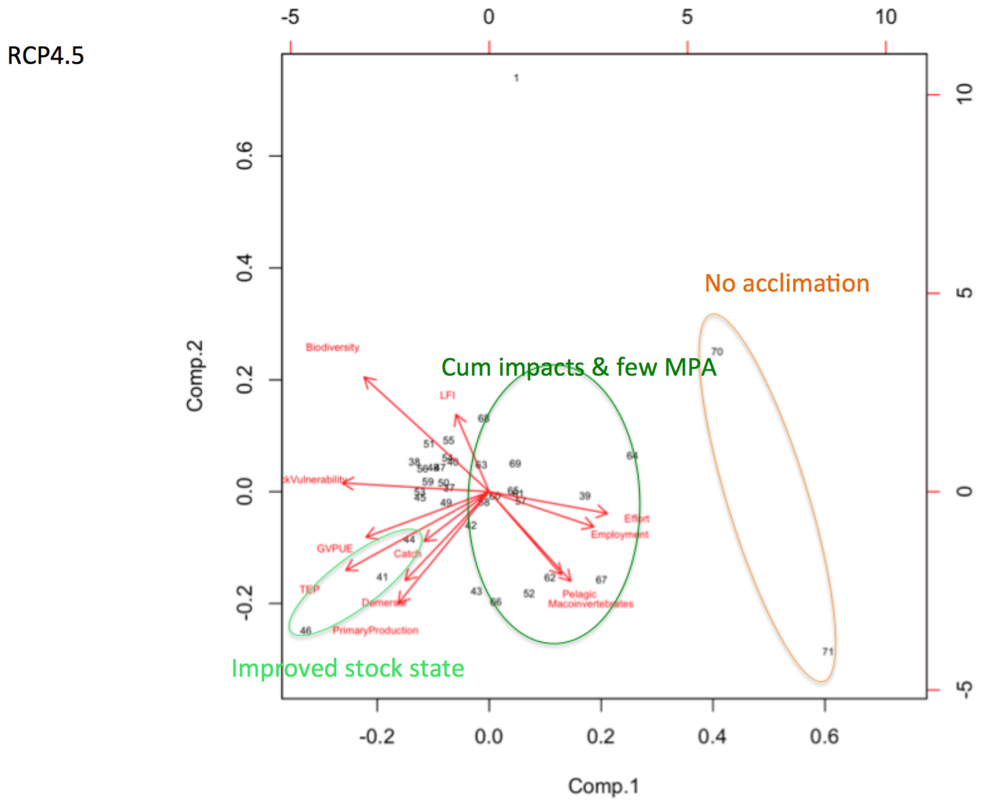


Figure 63: PCA biplot for Atlantis-SEAP simulations strategies and scenarios under RCP 4.5. Small numbers are IDs for individual strategy-scenario combinations.

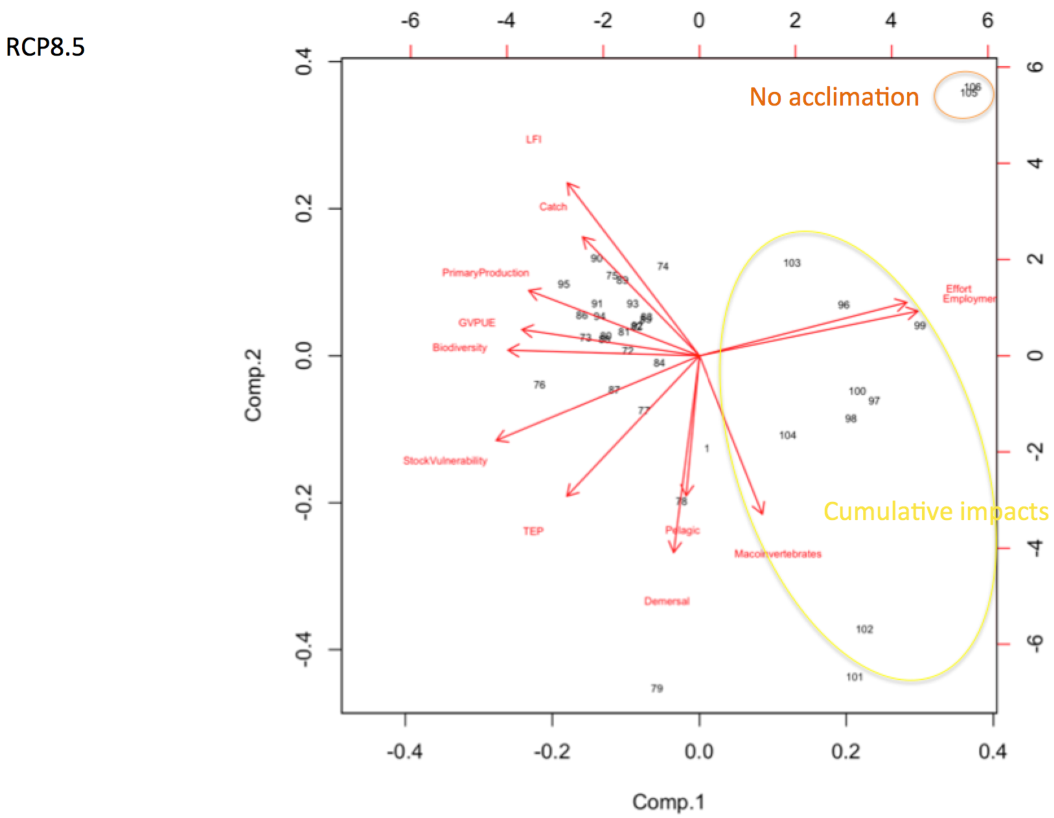


Figure 64: PCA biplot for Atlantis-SEAP simulations strategies and scenarios under RCP 8.5. Small numbers are IDs for individual strategy-scenario combinations.

group simulations with similar trade-off responses. Representative examples of these responses are provided in Figures 65-67. Patterns in performance are not as clear as for Atlantis-SE, with a number of strategies performing well against a few objectives but performing poorly against others. The strategy that had little spatial management performed poorly in terms of stock, conservation and employment objectives under all emissions scenarios, although it did see the highest employment. Seasonal closures, extensive spatial management and integrated management had similar levels of performance under RCP 3, with integrated management often leading the ranking vs conservation and stock objectives, but performing less well against the industry objectives. Extensive spatial management can do well against those objectives if parameterisations mean there is a good deal of spill over from closed area to fishing grounds. Under RCP 4.5 seasonal closures also performed well, as well as integrated management for many of the stock and biomass related objectives and better in terms of employment and landings. Under RCP 8.5 integrated management had the most consistent performance, but seasonal closures and slow assessment cycles could deliver when parameterisations saw pelagic groups increase and contribute proportionally more to total landings.

When the cumulative effects of climate, ocean acidification and all the marine and coastal industries and developments are considered then the performance of the various management strategies becomes even more mixed. No management strategy out performed the others across a majority of the objectives. In terms of the industry objectives, effort and employment are best met with seasonal closures, but slow assessment cycles tend to maximise catch (at the expense of stock status as the assessment process does not respond quickly enough to status changes). GVPUE is highest under extensive spatial management, but has been found previously (Fulton et al 2014), while the value per effort can be high (as catch rates are high) total landings can be so constrained as to fail to cover onshore costs, meaning the fishery is not economically viable. For the conservation and stock related objectives extensive closures (spatial or temporal) perform best. Integrated management shows a more even performance across all objectives.

Looking at the performance of integrated management under ecological, environmental and fish behaviour scenarios, this form of management performed similarly to that seen in Atlantis-SE. It is most effective when there are high levels of compliance. It can be undermined in intent when compliance is low, the fisher behaviour is primarily driven by short-term catch rates or when low costs (or other drivers) lead to and intensification of fishing pressure. Under the more moderate emissions scenarios the management strategy is capable of coping with fish kills, regime shifts and other non-linear system changes. It's capacity to respond rapidly enough is challenged under the highest emission scenarios.

INTERACTION EFFECTS

Consideration of the interaction effects amongst the various system forcing drivers active in the Atlantis-SEAP simulations had a similar outcome to those in Atlantis-SE. There are more additive responses expressed when emissions are lower emission scenarios, but synergistic interactions clearly dominate (Figure 68) and are at even higher levels then for Atlantis-SE.

While there was some overlap in groups found to be brokers and key players between the two models there are also some important differences too. In comparison with Atlantis-SE, within the Atlantis-SEAP simulations there were fewer differences in the groups identified as key players and brokers. Jellies, crabs, macrobenthos, seals, pelagic shark, lobster, cephalopods, abalone, toothed whales, urchins and krill were found to be key players in all instances for Atlantis-SEAP. Skates and rays were found to also have a key player role so long as acclimation was allowed for. Spikey dogshark was also found to be a fairly important key player under RCP 3. This list contains more traditionally identified species of management interest than the list for Atlantis-SE. Moreover, many of these key players are exploited in the various simulations, especially once the new fisheries are initiated. The degree of stress being placed on the inshore ecosystems under cumulative impacts and high emissions is clear when it is remembered that (the key player) abalone are extirpated in those simulations.

The list of broker species had a lot of overlap with the key players, but it is not a 1:1 match. Toothed whales, pelagic sharks, macrobenthos, shallow demersal fish, jellies and small temperate reef fish were found to be brokers under all emission scenarios. Seals are also a broker if there is no acclimation, whereas

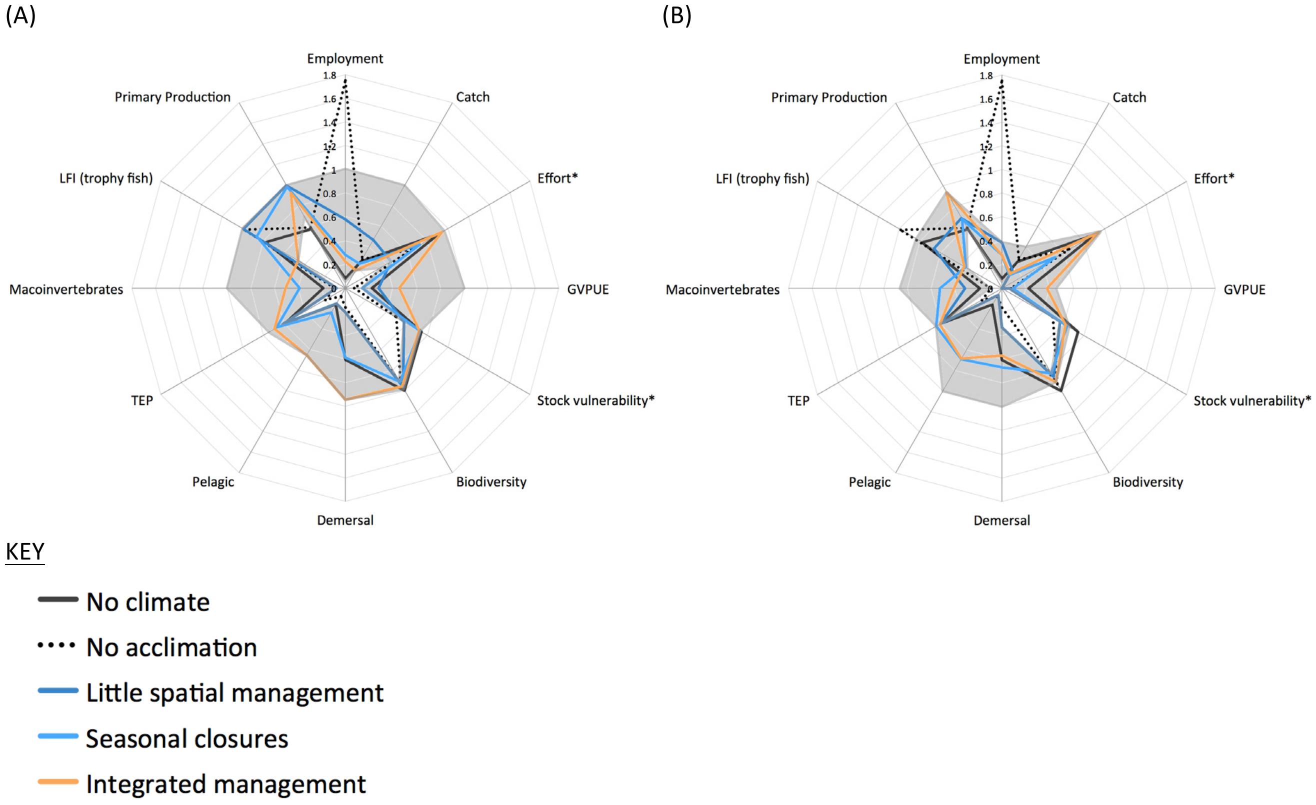


Figure 65: Trade-off plots for strategies in Atlantis-SEAP under RCP 3 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation), the axes marked with a * are inverted so the larger the value the better the performance and the catch objective has been rescaled so that it does not overwhelm the rest. The strategies shown represent each of the management performance clusters, except for (i) the fragmented management cases which are similar to little spatial management case, but with less employment, higher biomasses of macroinvertebrates and the highest LFI3; and (ii) for status quo (as of 2010) under cumulative impacts, which largely sat midway between the little spatial management and seasonal closures cases, except for much lower values of employment and macroinvertebrate biomasses.

[3] In response to the individual state managers responding to pressure from the recreational fishing lobby when setting annual management decisions.

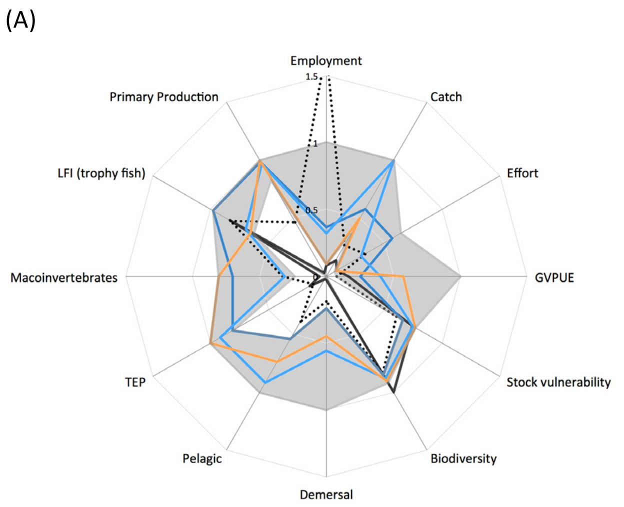
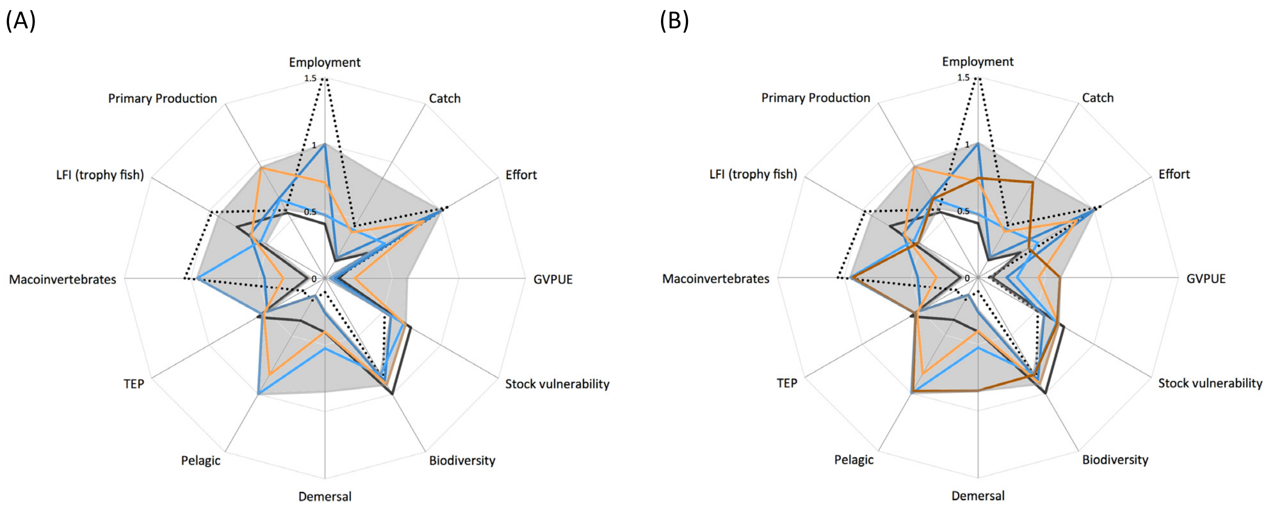


Figure 66: Trade-off plots for strategies in Atlantis-SEAP under RCP 4.5 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation), the axes marked with a * are inverted so the larger the value the better the performance and the catch objective has been rescaled so that it does not overwhelm the rest. The strategies shown represent each of the management performance clusters except for the case where a mesopelagic fishery is initiated, where the stock and conservation objectives were slightly lower than for seasonal closures, but the catch was the highest seen for this emissions scenario, but as it was concentrated largely in that single fishery employment and effort were quite low overall. Key as for Figure 65.



KEY

- No climate
- No acclimation
- Little spatial management
- Seasonal closures
- Integrated management
- Extensive spatial zoning

Figure 67: Trade-off plots for strategies in Atlantis-SEAP under RCP 8.5 (a) with non fisheries/aquaculture at 2010 levels and (b) with cumulative impacts. The no climate change case is given for reference, the grey area covers the range of outcomes across all performance clusters, the axes are scaled vs the greatest performance under any strategy or scenario (with acclimation), the axes marked with a * are inverted so the larger the value the better the performance and the catch objective has been rescaled so that it does not overwhelm the rest. The strategies shown represent each of the management performance clusters.

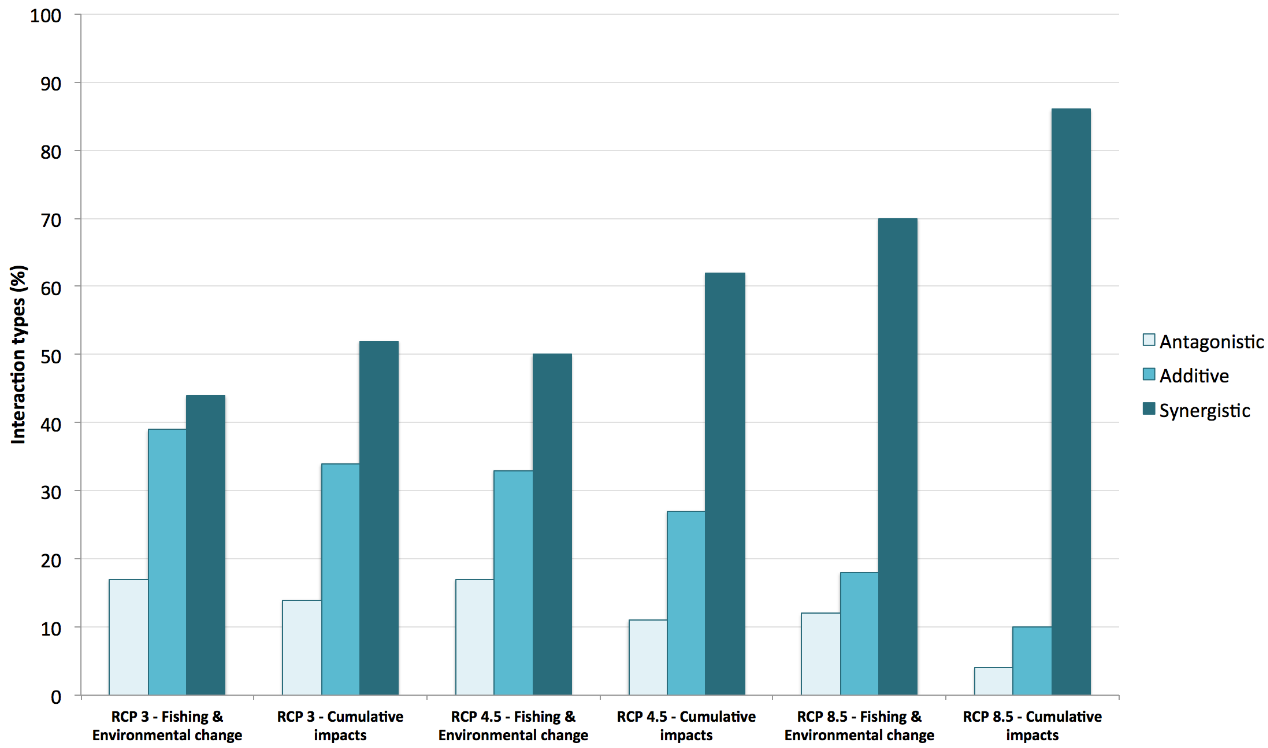


Figure 68: Interaction effects for Atlantis-SEAP – results for cumulative impacts and fishing and environmental drivers (with all marine industries held at 2010 levels) shown separately for each emissions scenario.

spikey dogshark is a broker if acclimation is included. Crabs were found to be brokers except under RCP 3, whereas filter feeders were amongst the broker groups for RCP 8.5. Interestingly, aquaculture molluscs (which can feed on plankton) is also marked out as a broker group under RCP 8.5.

SPATIAL EFFECTS

There is quite a lot of spatial differentiation in Atlantis-SEAP. The explicit representation of reef areas means that reef associated groups are already constrained in distribution, but are further constrained as temperatures become unsuitable in some locations under the higher emission scenarios and extreme events. Abalone, in particular, is constrained in distribution, often eventually only restricted to the waters around Tasmania (and disappearing from even there under cumulative impacts).

As with Atlantis-SE, blooms and extreme events included in some of the simulated scenarios are spatially restricted meaning their ecological affects are too. For example, the increases in eddy driven pumping off eastern Tasmania and Victoria sees upwelling driven blooms along that entire shelf break, even as primary production drops across the Great Australian Bight. Both the surface feeding pelagics (mackerels, small pelagics and the oceanic planktivores) as well as mesopelagics increase gather in this region of higher production. Piscivorous predators also concentrate in these areas too, with abundance depressed elsewhere (both in northern NSW and western Victoria and South Australia). As temperatures rise some of the demersal species are also forced further south, though access to appropriate habitat and forage means that while their depth distribution deepens a little the main component of their shifted distribution is to move south. Flathead in particular move in this way, especially if there is no acclimation. In contrast the stripey tuna find the waters of southeastern Australia increasingly attractive.

As the fisheries model is CPUE based the spatial allocation of the effort fairly quickly comes to mirror the distribution of the target groups. The majority of the new fisheries develop in eastern Victoria and Tasmanian waters, which means that not only are fisheries in southern QLD, NSW and South Australia losing access to groups that shift south (i.e. are under economic pressure as they can no longer access the product), but they are not in the most productive areas for many of the new fisheries either and do not benefit form them very much. These affects are mitigated if centralised management allows for quota-based allocation (or equivalent) and mobility of access across state boarders.

Spatial management and cost-based restrictions to fisheries access can also add to the biomass mosaic by removing fishing pressure from some regions. When costs are lowered, or the flexibility of fishers to update effort distributions based on the most recent CPUE patterns rather than past recollections, there can be significant shifts in the spatial footprint of the fisheries. Under the former fishing pressure extends into every box of the model, though is most concentrated around high productivity areas close to ports. When fisher flexibility is increased the fisheries spatially contract to the hotspots, chasing them around the model domain as environmental properties shift or areas are depleted in relation to catch rates found elsewhere.

Discussion

Future system states: challenges are for fisheries and aquaculture management

There were four objectives for this project. The first is to assess what challenges exist for fisheries and aquaculture management within a changing climate. If the detail behind each species under each development and climate scenario is considered through time there is an overwhelming amount of information pertinent to this topic. It is infeasible to discuss all that detail here so the authors encourage interested readers to explore outcomes via the tables reported here or in **sea**view or to contact the authors for further details. Instead more general findings, applicable to all interested in the region will be discussed here.

Perhaps the greatest challenge facing managers of southeastern Australian fisheries and aquaculture is that they don't know how the global human population will respond in the coming decades and so what emissions will actually be. Given the differing degrees of system change seen under the different emissions scenarios it is clear that strategic decisions and investments would be very different if managers knew beforehand which trajectory they were on. Unfortunately, that will never be the case so managers will need to remain flexible and adaptable if they are to successfully negotiate such an uncertain future. In essence this is no different to the premise behind adaptive management (Holling 1978, Walters 1986, Ostrom et al 1999, Dietz et al 2003) or the evolving idea of governance based on resilience thinking (Lebel et al 2006, Walker et al 2006, Allen and Holling 2010). Nevertheless it is more complicated (and challenging) as it must be accomplished against a background of non-stationary system drivers. Resource management still largely depends on ideas born of equilibrium ideas – comprehensive, adequate and representative reserves that are fixed in space, fixed reference points. While new management methods may be found in the coming decades, for now the way forward appears to be by modifying well accepted management procedures so that they are more non-stationary – such as allowing for regime shifts in assessments (Wayte 2013), allowing for non-stationarity in management strategies (A'Mar et al 2009) or using dynamic forms of once stationary management levers, such as fisheries closures based on water bodies rather than a fixed geographic location (Hobday et al 2010). General concepts of how such modifications could be made will be the most useful information to share as system idiosyncrasies will mean universal solutions will likely not exist. For example, even within the southeast region it is already known (i) that there will be differential environmental change across the region, west to east as well as north to south (Matear et al 2013); and (ii) that the relationship between attributes and indicators varies on regional scales (Smith et al 2011b).

In terms of challenges posed by changed system state and function, the easiest challenges to articulate are the environmental drivers and the resulting shifts in the food web. Current climate projections indicate that under RCP 3 there should be relatively small changes in average annual sea surface temperatures, by 2070 these should only rise by 0.6 °C to the west of Tasmania and 1.5 °C to the east (IPCC 2013, 2014). Under RCP 4.5 these temperature shifts become 1.5 °C in the west and 2.5 °C in the east. The most extreme change is seen under RCP 8.5 when the temperature increases reach approximately 2.5 °C in the east and 4 °C in the west. While the models used to create these projections are becoming more resolved all the time, they are still not eddy resolving ay a global scale and so can mis-state potential shifts. This is illustrated in the work by Matear et al (2013) which shows that once eddy pumping is resolved in the models the locations of potential production shift substantially (from the Bonnie coast in the coarse models to the Tasman Sea in the more finely resolved models). While the patterns from the downscaled, more finely resolved, model was used in this work and so avoids the issues found with the currents taken from coarse global models this is not to say that more surprises won't be found in future more refined coupled ocean-atmosphere models that resolve ever more of the finer scale processes.

Another major area of physical uncertainty that management will need to deal with is climate variability, as the environment will not shift in smooth slowly changing trajectories. The current slowing of global ocean warming, as decadal scale patterns of periodic cooling interact with the warming trends are a prime example of this variability (IPCC 2013, Figure 69). In the next few decades climate variability will dominate over climate trends. Longer-term climate variability will still be important as it will influence the conditions experienced and potentially contribute to the frequency and intensity of extreme events. Science is only just beginning to understand what drives variability. For Australian waters variability has recently been found to be conditioned on the southern annular mode (in the waters and atmosphere around Antarctica) and wave trains across the South Pacific (Risbey et al 2009, O'Kane et al 2013). With this new understanding it may be possible in the coming years to forecast this variability, but for now the projections used in this research had to rely on assumptions and scenarios that posited smooth change or step changes. The simulations suggest that managers will find it much harder to deal with sudden system shifts rather than smooth change. Coping with trending change is non-trivial in their own right, but dealing with sudden and large change is much harder, especially in the decade following the change – as the shift has to be recognised, the degree quantified and the causes attributed.

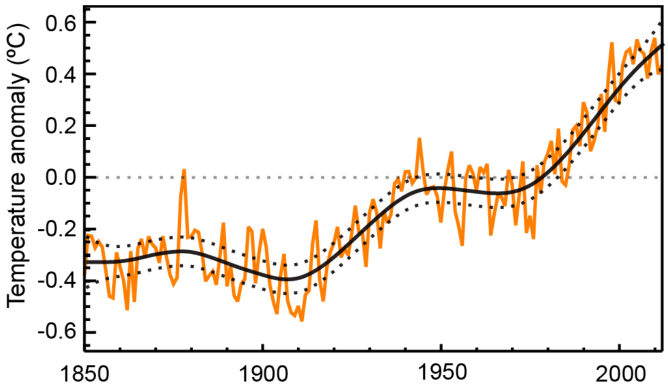


Figure 69: Global mean surface temperature (GMST) anomalies relative to a 1961–1990 climatology, from HadCRUT4 annual data, with smoothing spline (solid curve) and its 90% confidence interval (dashed lines) showing oscillations in temperature pattern through time (reproduced with permission from IPCC 2013).

Managers will know that physical drivers portend industry and ecological shifts and as such may use physical water column properties as indices for informing management. Nevertheless, it is the ecological consequences they will really be responding to. Aquaculture, especially for salmon but potentially also for bivalves and abalone will face significant issues going forward under all but the most modest of warming scenarios. Based on the Atlantis-SEAP projections, salmon aquaculture and abalone dive fisheries appear to face the greatest threats from global change. Ecosystem restructuring, and what that means for system function and what can be sustainably harvested, will likely be a significant issue under RCP 4.5 and 8.5. While there is some restructuring under RCP 3 it is nowhere near as great. This is not to say it will be an easy road dealing with even the minimum of climate induced stock status shifts, as can already be seen along the east coast of Australia (e.g. the influence of range extending species on demersal reef and macroalgal dynamics in Tasmania; Ling et al 2008, 2009, Last et al 2011).

Australia, along with a number of other nations, has adopted an ecosystem based management (EBM) approach. The intention behind this is to forestall negative outcomes of exploitation and use of ocean systems by considering management of all parts of the ecosystem rather than simply focusing on fisheries target species one at a time. In the context of future change, this means going beyond needing to adjust allowable catches (and other management levers) as stocks shift, or otherwise respond to the climate drivers and affects of coastal developments and marine industries, to think about which groups maintain system cohesiveness – which are the brokers and key players. The model analysis suggests that the current management approaches (fisheries and conservation) will already be dealing with at least some of the key groups identified as important, especially for the modelled inshore systems. Large pelagic sharks (e.g. white sharks), skates and rays and iconic mammals like seals and orcas are already of keen conservation interest, as are reef complexes and the fish assemblages they support. These groups, especially the large sharks, are generalist predators, which terminally connect many of the modelled sub-webs.

Similarly, urchins, abalone and lobster and some demersal and reef fish are already talking points for fisheries regulators in the state agencies of southeast Australia. They are not only key target species but are groups that are known to structure the physical as well as trophic forms of coastal ecosystems (Ling 2008). The role of shallow demersal fish is perhaps not as appreciated as the rest, but it's a key player because this composite group replaces, or at least competes with, many of the key fished demersal species. Thus the role of this group increases as fished groups decline and is where much of the coastal finfish biodiversity turnover is likely to occur in the next few decades.

While the plankton groups found to be important in the models may not have been of prime fisheries management concerns they have received careful attention from water quality monitoring bodies and biological oceanographers tracking oceanic productivity. This is an example of where allowing more cross flow of information amongst agencies (a must for effective integrated management) could benefit management decision making without significant financial or logistical impost. While bodies monitoring receiving water have had water quality and human health issues as a focus, in terms of fisheries and aquaculture these groups are important because large phytoplankton are the primary production support for the system, particularly the more offshore systems, with large carnivorous zooplankton linking them to the higher trophic levels. This linkage is consistent with our finding that these groups transmit stress effects to the macrofaunal webs rapidly. Small phytoplankton are also a key broker, as they support alternative production pathways that feed through the microbial food web to higher trophic levels. The dominance of this alternative pathway may be triggered by trophic cascades, climate and other environmental change and cumulative impacts; this is particularly the case in the most highly modified inshore waters around human settlements and nutrient outflows.

Cephalopods, both squid and octopus, do receive some research, conservation and fisheries management interest, but perhaps not to the level equivalent to the key shaping role they could have on future shelf ecosystems. These groups, along with chondrichthyans form antagonistic network connections that buffer the system against change. While an increase in their dominance is a significant system shift in itself, on longer time scales (e.g. many decades to a century) it is a transitory pattern that buffers the system from still larger restructuring and loss of ecosystem function that would occur if other key species are removed. Unfortunately, there is uncertainty as to the true robustness of these groups. The robust performance of sharks and rays under most parameterisations may be an artefact of a lack of understanding of how climate change and ocean acidification will effect these large predatory groups (similarly for other large bodied vertebrates like mammals). While more is known of cephalopod responses their life history is both their strength and weakness. Their productivity and relative short life spans means they can adapt quickly, but it also means they lack the buffering capacity of longer life spans, showing much more volatility – they are quite sensitive to strings of stochastic events, as their short life histories mean they have little in reserve at a population level to survive multiple poor years. Consequently, it is possible that under extreme climate change and increasing regional human impacts these species may decline to the point that buffering pathways are undermined or dismantled in effect. This level of change would present the managers of the day with significant and immediate challenges.

Jellyfish are an interesting group to consider as both an indicator species and as a key player in marine ecosystems. Models have for many years now found them to be important indicators of system state and important to food web dynamics (e.g. Fulton et al 2005a); jellyfish are becoming a topic of increasing public interest[4]. However, there is much debate in the literature as available time series data is insufficient to determine whether jellyfish abundance is really rising globally (Condon et al 2012, Duarte et al 2013) and without more effective means of sampling them in an inexpensive way it could be some time before they feature in management reporting documents.

Offshore, the models suggest that mesopelagics are one of the most important groups, identified as a positionally important prey species they have the most number of direct connections to predator species (e.g. cephalopods, piscivorous and demersal fish) and transmit negative stress responses by both direct and indirect interactions. Mesopelagics are another set of species that historically have not received much

[4] The popular science book *Stung!* (Gershwin 2013) has received broad media coverage. There has also been close to a doubling in the number of new stories and headlines in the popular press relating to jellyfish in the last 6 years - based on a Google trends search (http://www.google.com.au/trends/) on "jellyfish" targeting only the Australian region.

management, industry (or even scientific) attention. However, their key role in ecosystems around the world is beginning to be appreciated (Kloser et al 2009, Irigoien et al 2014) and it is unlikely that such a large potential protein source will go unexploited for too much longer. Under classical fisheries theory the fish productivity of these short-lived species, coupled with high biomasses, would make them prime fisheries targets should a market develop. The important role of mesopelagics as a major prey item and their potential vulnerability to shifting food web structure under climate change or shoaling of hypoxic water (seen under many of the RCP 8.5 simulations) has significant implications for the resilience of the southeast Australian offshore food web. The loss or depletion of these species would have a disproportionate negative impact on the energy flow between trophic levels and within trophic groups. While there is the potential for some expansion of other planktivorous groups to fill this vacated niche, the expansions seen in the modelled scenarios were insufficient to fully compensate for the reduction in mesopelagic biomasses. Their critical role underlines how important it will to carefully manage any direct targeting of this species, which is consistent with the warnings given in Smith et al (2011a). The results of Griffith et al (in review) and the interaction analyses presented here indicate that for the commercially exploited southeastern Australian ecosystem, focusing on conservation and management of mesopelagic species may provide greater than expected returns in protecting the food web from both direct and indirect synergistic effects of fishing and climate change on predator-prey relationships.

While these results provide general guidelines uncertainty around potential responses is as important a challenge for managers at the present moment as the physical uncertainty. The range of potential outcomes was quite broad in both models. In terms of general trends there was a good deal of convergence across parameterisations for Atlantis-SE, but there were still many cases where long term outcomes were dependent on parameterisations and specific circumstances, meaning overall groups like large pelagic fish were equally likely to increase as decrease. This was even more of an issue for Atlantis-SEAP where the range of potential biomasses was an order of magnitude broader than for Atlantis-SE and where many groups (e.g. banded morwong) could potentially increase or decrease depending on which of the plausible parameterisations is used. Looking at the trajectories through time across models the larger invertebrates and detritus-based food web responds similarly across both models. The primary producers in the two models respond somewhat differently, in Atlantis-SE there is a gradient in the degree of increasing productivity (higher when emissions are lower), whereas under Atlantis-SEAP there is a strong nonlinearity both within and between emissions scenarios (with RCP 3 showing little increase, RCP 4.5 growing strongly and 8.5 initially growing more rapidly before falling away). Moreover, the pattern seen in Atlantis-SEAP is carried through zooplankton and jellyfish, a damped form is seen in the detritus web, and even the predatory large pelagic fish, mammals and seabirds. It is not seen in forage fish to the same degree as they are also effected by the predation and fishing pressure they are under. Interestingly, the response by demersal sharks is almost opposite across the models; under Atlantis-SEAP sharks are another with a dampened reflection of the primary production signature (with strong increase under RCP 4.5 and less growth under the others and eventually a decrease under RPC8.5) whereas in Atlantis-SE there is a strong increase under RCP 8.5, but only a moderate increase under the other emission scenarios (which can not be distinguished, as the food web shift allowing for the increase under RCP 8.5 does not persist unless the atmospheric pCO_2e remains above approximately 650ppm). In terms of the shape of the ecosystem trajectories there are two gross patterns, one that increases through time and one that slowly increases to 2040-2055 before shifting into a new phase – often this phase is to drop away, but under RCP 8.5 it can be further accelerating increase. The former occurs when the benefits of temperature shifts (often under RCP 8.5) is overwhelmed by acidification or cumulative effects. The acceleration occurs when the system enters a much more productive alternative state. The path dependency of this state means that the entry window is not encountered under RCP 8.5. This pattern of behaviour is much more obvious in Atlantis-SEAP, where the signature in the primary producers is carried much further through the trophic web.

A different aspect of the biological uncertainty is in the specific response functions. Even with acclimation and evolution the modelled abalone in Atlantis-SEAP do not survive at significant biomass levels beyond 2045 for RCP 4.5 and 8.5 or beyond 2060 under RCP 3, the response functions (changing fecundity, thermal tolerance and vulnerability to predation) are based on laboratory data and thus is uncertain in terms of wild stock and their ability to adapt to the changed conditions. Until more information on all life history stages is available the veracity of this outcome remains in question. While some of the variability and uncertainty across the model groups will be constrained with new (as yet uncollected) information and future model refinements it is likely that new uncertainties will be uncovered. For instance, the physical processes captured in the models used to force hydrodynamics have changed through time and this is in part why findings from Brown et al (2009), Fulton (2011) and those reported here do not always agree. The challenges presented by uncertainty will never be expunged, and may even grow as system bifurcation points are approached, even more reason why retaining adaptive and integrated management is important going forward.

Despite all the uncertainty in physical and biological processes and responses, all models indicate that demersal food webs generally show stronger potential declines than pelagic food webs (under all productivity parameterisations). This present a further challenge for fisheries and aquaculture managers given the reliance on demersal food webs for much of Australia's fish production. It appears that via acclimation and evolution that there is substantial capacity for adaptation in Australia's demersal (and pelagic) ecosystems – via distributional changes and life history adaptation (e.g. changing growth rates and metabolic tolerance). All of these mechanisms are active under all emission scenarios, however under RCP 8.5 the model suggests that some of the physiological adaptations can be overwhelmed seeing vulnerable species becoming reliant upon spatial distributional changes. In extreme cases this can lead to the extirpation of the most vulnerable and sensitive species, which push the furthest poleward, as they eventually run out of suitable habitat (see an example for lobsters in Figure 70). Such distributional shifts are not only challenging in the aggregate sense of conserving vulnerable species, but will raise social and industry challenges for management well before then (the first cases of which have already begun to arise). Under the state-based jurisdictions currently in place for many coastal fisheries shifts in spatial distributions present multiple access, allocation and legal quandaries. While aquaculture will not have to grapple so much with shifting stocks it will face analogous issues around gaining access to suitable grow out locations (as environmental drivers shift and previously used locations become less suitable) given the already crowded nature of south eastern marine waters and the development of new industries, such as energy and aggregate mining.

Without centralised management (or cooperation across jurisdictions) local stress for fishing communities can become significant if a range extending species does not just extend its range but contracts at the equatorial end of its range. Not only do fishers in the range of contraction face an immediate loss of stock access, but current legislated responses to stock declines (which tend to assume human exploitation or

Figure 70: Schematic map of shift in the centre of the rock lobster distribution through time in Atlantis-SE for the cumulative impacts development scenario, status quo (as of 2010) management strategy under RCP 8.5 emissions scenario.

direct affects as the primary cause of declines) can lock all those concerned into specific management actions which may do nothing for the stock – especially if it is a health population which is just shifting its centre of gravity rather than declining overall. It may also not be a simple case of flagging range shifted species and exempting them from some legislation, as the information available to data suggest that attribution of climate drivers as the main source of change behind shifts in species abundance are not consistent across declines and increases. Declining local stocks, particularly of targeted species, is much more likely to be attributed to fisheries rather than climate drivers, even by fishers (van Putten et al in review).

Even more complicated jurisdictional and resource sharing issues arise when the spatial distribution across life histories becomes extended. The successful management of straddling stocks have been a topic of debate for many decades now (with the UN agreement on straddling and highly migratory fish stocks adopted in 1995), but have potential to become more of an issue within southeastern waters in the coming decades. Larval dispersal is implicitly handled in Atlantis, but even here there was evidence that if there is differential mobility and physiological tolerances across life history stages that shallow water species (e.g. some reef species) may end up relying on a small number of productive "source" spawning locations supporting the exploited populations in locations downstream, which could be in different states or jurisdictional areas to the spawning sites. This raises thorny questions about relative responsibility and benefit and how to effectively recompense societies surrounding the source populations which must act for the benefit of downstream users. Psychological research suggests that humans find learning from and acting on information temporally or spatially remote from them quite difficult and often do not do it well (at least not without significant support; Kahneman 2011). Scientifically there would also be the need for more dedicated modelling tools (e.g. Lagarangian larval and connectivity models) would be required to explore these issues in more depth.

Range extending species can give rise to cross sector allocation issues as well. For instance, if a species is particularly attractive to recreational fishers when should commercial fishers be allowed access? Should species be allowed to establish first or can fisheries (recreational or otherwise) be allowed even before life histories are locally closed, effectively skimming up the ecological spill over? Decisions regarding relative allocations across recreational and commercial fisheries remain the purview of society more broadly. Given that landings by recreational fisheries can match those from commercial fisheries for some inshore stocks it is safe to say that access to establishing stocks will remain a management challenge and one subject to information regarding what the presence of that group means for the resilience of local ecosystems. Where groups present threats to the fundamental structuring mechanisms of an ecosystem (e.g. *Centrostephanus*) it may make sense to allow fisheries targeting them to act like a pest eradication program, preventing their effective establishment. However other species (such as some of the reef and demersal fishes) which may also cause disruption and transitory shifts in the ecosystem represent biodiversity turnover, replacing other species which can no longer maintain their role under the shifting environmental conditions. If the range extending species in that case was fished heavily to prevent its establishment then functional diversity and ecosystem function could be at risk in the long term. What this means is despite the desire to minimise apparently unnecessary expenditure and have robust rules that can be applied generally, it will be necessary for managers (and the researchers supporting them) to act on a case-by-case basis, evaluating what role the new species will have in a future ecosystem. General rules and decision trees may eventually evolve (and early candidates already exist in some state jurisdictions, da Silva *pers. comm.*) but at the present uncertainty is too high to create firm guidelines that are universally applicable.

Going forward not all new fisheries will focus on range extending species. It is likely that other species will be added to the Australian palate or become the focus of export markets. Developmental fisheries exist for a small number of invertebrates in Queensland, NSW, Victoria and South Australia (e.g. for sea cucumbers or jelly fish). While the future status of these specific fisheries is uncertain the new fisheries explored in the Atlantis models all involve rapid life histories that have not been the typical focus of Australian stock assessments (krill, kelp, holothurians, jellyfish and mesopelagics). This means that the development of appropriate assessment skills will be yet another challenge facing managers in the region.

There are other social and economic challenges that will need to be addressed by fisheries and aquaculture regulators. The vagaries of fisheries markets could not be addressed here, but uncertainty in these (and associated demand) will likely be as great as the biological and physical uncertainty discussed above. If the kind of contraction in ownership, and potentially employment as fisheries shift to more automation or less labour intensive collection methods, there will also be social challenges posed to regulators around equity of access to benefits from these public resources. A hint of that is beginning in the arguments around the social licence held be extractive marine industries. Social licence of commercial fisheries has become a growing issue in the developed world, particularly as public perceptions about the status of stocks may not have kept pace with changing fisheries regulations or may not be sourced from information that is relevant for Australia. The debate around the use of a large factor trawler is a good illustration of how social perception may challenge evidence based management decisions (Tracey et al 2013). The model simulations suggest this gulf between the public and more directly involved stakeholders will likely remain an issue. For example, the models suggest that large vessels may be the most ecologically (and economically) sustainable way of maintaining productive fisheries under high emissions and cumulative impacts. Something that may be unlikely to find wide public support at present. It is likely that other disconnects between effective management options and public perception exist and methods need to be found to find some common ground (Hobday et al 2014) or of effectively communicating the need and changing status of fisheries if management is to minimise conflict in the future. This is not something that is only of concern for fisheries managers. As aquaculture grows or enters new areas public perceptions regarding potential pollution and the quality of the product will need to be addressed; online fact sheets from Australian aquaculture producers suggest that these issues are already something they the producers have to deal with.

Sustainable management arrangements

MODEL FINDINGS

The second objective of this project was to inform on which management arrangements provide for sustainable management of the resource, provide for efficient operation of markets, foster industry adaptation and enable businesses to manage challenges and take advantage of any emerging opportunities in the face of future uncertainty. This is a question that is being increasingly asked of strategic models like Atlantis. The conclusion reached in this project matches what has been found in a number of previous fisheries and coastal management modelling studies considering alternative futures and sustainable management – Integrated management, addressing the interaction of the multiple users of the marine and coastal environments that supplements the dedicated management efforts by the regulatory bodies focused on the individual industries, has the most consistent and balanced performance across the multiple objectives held for marine ecosystems (Fulton et al 2011, Fulton et al 2014). Targeted management options can perform more strongly for individual management objectives (e.g. extensive spatial management can lead to improved stock status for large bodied habitat associated predatory fish), but they do not successfully meet minimum requirements across multiple objectives. One clear result was that a reduction in spatial management was a universally poor management action. Other model results, such as the success of seasonal closures as a management action must be treated with caution as their feasibility of successfully implementing them effectively in reality is low based on the history of the use of this kind of management in North American fisheries (Emery et al 2014).

Some of the same caution can be levelled at the performance of integrated management as how such management would function in reality is not yet clear. Multiple options exist. For example many European nations opting for reliance on spatial zoning (where a region is broken up into areas with permitted uses assigned per area) as means of allowing equitable access and use to multiple sectors (Douvere and Ehler 2009). The other major option is to create a committee or dedicated regulatory body that oversees the integration and facilitates communication between the sectors. Such bodies have had mixed success to date and have often been short lived, typically because they have not had a clear jurisdictional or legislative mandate and were considered to be an extra layer on existing regulatory obligations. If these shortcomings can be addressed such management may prove the functional way forward. It will still face day-to-day operational challenges, as the socioecological system it is embedded shifts around it, management of ecosystems will never be a simple process and will always require a mix if management levers and tradeoffs between objectives (Kinzig et al 2006). True adaptive management will continue to be a central tenet of successful management under uncertainty, ever more so as the system continues to shift about. The long delay times and effective "one-offs" of coastal development and marine industrial development will be testing for the adaptive management tenets as it is hard to effectively learn under such conditions. Nevertheless, component industries can still apply the approach to their own decision marine processes and take broad learning from cross system and development comparisons, system approaches and the use of strategic planning tools.

Substantial shifts in management are not unheard of. The commonwealth SESSF fishery is a good example of such a shift. The form of management now used in the SESSF is a form of integrated management applied at a fishery scale – combining gear, quota, spatial and other management levers so that habitat, stock, conservation, management efficiency and economic objectives can be meet simultaneously. This focus on integrated management is prominent in the Australian Ministerial Direction of 2005 (available at www.daff.gov.au/fisheries/domestic/fishingfuture) that reshaped the management of the SESSF and other federal fisheries. Discussions regarding the restructuring of the fishery were supported by information from a strategic assessment project that considered possible alternative futures for the fishery (Smith et al 2009). That project included an integrated (multi-lever) management strategy, but that strategy was so far removed from the management practices used in the SESSF prior to 2005 (and the alternative management schemes proposed by stakeholders for serious consideration in that project) that it was originally referred to as the 'blue sky' strategy. Yet, by the time the project finished the management had transformed to the point that many features of the integrated management strategy considered in the project had become almost business as usual. This is a clear demonstration that at least within a sector that workable integrated solutions to ecosystem based management (that had to negotiate tensions across multiple types of fisheries as well as conservation and fisheries objectives) can be found. The integrated mix of management methods required in that case (a balanced combination of a variety of input, output and technical management measures) also shows that no single management technique will suffice for addressing the multitude of objectives involved in sustainable ecosystem based management – single management levers were not sufficient for a single industry (Fulton et al 2014) so there is no reason to believe that they would serve any better across multiple sectors in a shifting environmental context.

In finding a pathway to cross-sectoral integrated management it is likely that many steps will be needed along the way. The first of which is applying integrated management within fisheries alone, both within individual fisheries (as was done for the SESSF) and across fisheries active in the same region. Status quo management already captures many aspects of ecosystem based integrated management (especially for the SESSF where it has become the status quo) and this is why it can perform acceptably in the long term in some instances. Modification to the approach to get integration and alignment across fisheries (and ultimately complimentary actions across industries) can improve the performance, but the idea of using a balanced combination of management levers to address the different objectives is the fundamental starting point. A step toward achieving that integration is a movement to centralised management for stocks over the entire region. While this was insufficient to be the 'best' performing management strategy by itself in the long term it always out performed fragmented state-by-state management and achieved to an acceptable level in the short to medium term (when the system had not diverged too much from today). This piece-by-piece construction of an integrated approach – a mix of management levers (input, output, technical etc) with single fisheries; single management bodies for stocks across jurisdictions; agreed common approaches, objectives and integration of actions across fisheries to meet ecosystem based management concepts; and ultimately integrated multiple use management – may be the most feasible way forward. There should be a no regrets outcome of such an approach as each step should materially advance the resilience of the ecosystem and the industries dependent upon it, though costs may be the constraining factor. A multi-million dollar package underlay the restructuring of the SESSF but that is unlikely to be available in all instances. The other thing that could trip up such an incremental approach is that it may take considerable time to bed down, time the ecosystem managers may not have if emissions are high and system thresholds encountered.

It is also important to caution however that no simulations were performed where one form of management transitioned into another. This project only considered strategies where the general form of management was in place throughout – the decision making process (i.e. quota levels etc) were adaptive but there was no transition from one form of management to another mid-stream. It is possible that some 'optimal' sequence of management shifts could be found by iteratively 'gaming' the system to check for path dependency (this is effectively the principle behind how maximum economic yield is found in bioeconomics models). It was decided not to do that however, as doing this at an ecosystem level is exceptionally difficult and may prove deceptive as it would only be found through an iterative search and reality isn't iterative, we can not rewind and try again given what we find next year. This means that the specific sequence of possible steps toward cross-sector integrated management is untested. However, the simulations do indicate that in the short term there is little to differentiate these forms of management and that while they individually perform reasonably well against the performance objectives, there is incremental value in the long term in the ever more integrated approaches. This suggests that the sequence should be beneficial with each constituent step beneficial in its own right.

DELAYS IN GOVERNANCE

There are many ways in which the performance of integrated management can be undermined – when there is a lack of compliance or when other drivers (e.g. potentially market forces or pressures associated with food security) encourage the development of intensive fishing pressure. One thing that can undermine the performance of many management approaches is delays in the governance system. Under RCP 3 a slow assessment cycle has moderate performance but is less and less effective under higher emission scenarios. It can allow significant catches and in some instances GVPUE (meeting some industry objectives) but at the cost of conservation objectives, particularly under cumulative impacts.

This concurs with findings by Brown et al (2012) who used simulation experiments to explore the implications of delays in management actions when the system is transitioning to a new state or under a directional driver (as is the case with climate change driven environmental shifts in southeast Australia). Brown et al (2012) found that delays in management actions when a stock had static or declining productivity (e.g. due to environmental change) resulted in a greater probability of collapse (as a result of overfishing during periods with poor environmental conditions) and lower long-term stock biomasses (Figure 71) regardless of the life history of the species (i.e. whether slow or fast growing, high or low productivity). While few stocks completely collapsed in the simulations considered in the present study the average final stock status of target species in Atlantis-SEAP was almost universally lower under slow assessment cycles. The outcomes were more mixed under Atlantis-SE, but under RCP 3 it typically lead to lower stock status and under the higher emissions slow assessment cycles lead to lower stock status in roughly half of the simulations.

Brown et al (2012) also found that catch varied less often through time with delays in the management system, but when change did occur it was often in much larger steps (to account for periods of overfishing in populations with declining productivity) ultimately ending with a 40% drop in harvest over 50 years. Similar things were found under the RCP 8.5 in this project. Under RCP 3 and 4.5 there wasn't as a distinct drops in final catches with slower assessment cycles, but for RCP 8.5 the catches under other management strategies were higher for 75% of the Atlantis-SE simulations. Thus delays in the assessment cycle provide a perception of stability in the short term, but in the long term a more responsive assessment system performs more strongly. The biodiversity turnover and contribution by new fisheries and range extending species to total catches in Atlantis-SEAP mean that the situation is a lot less clear for that model. The slow assessment cycles performing poorly for current target species in that model, but does not lead to poorer catches overall because the catches of the new target species compensates for the drops in other groups.

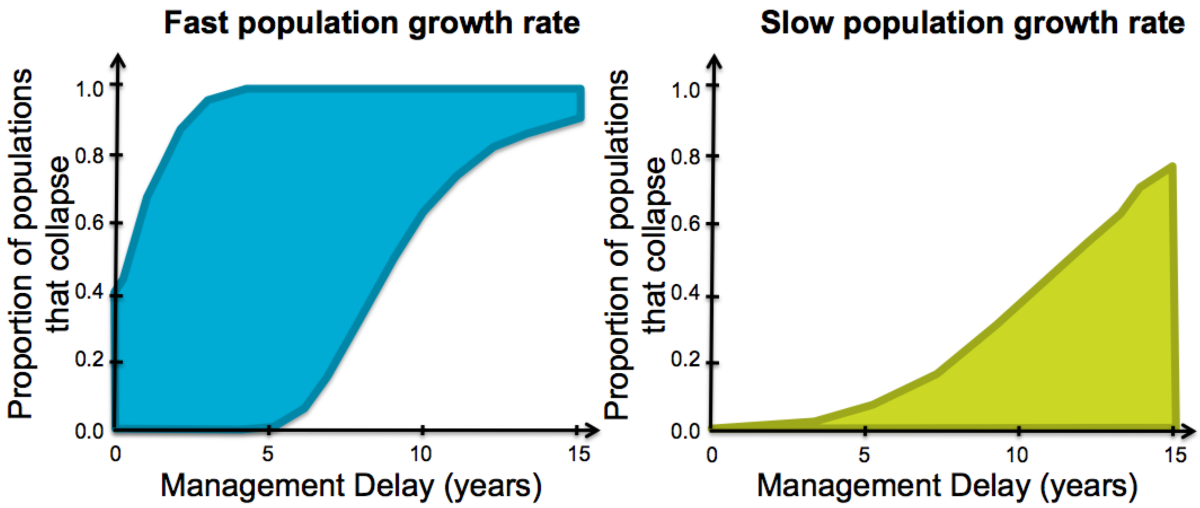


Figure 71: Probability of collapse for species with fast or slow life histories and management delays of different lengths (the coloured areas in each plot indicate the range of probabilities produced under different levels of inter annual variability and observation error in the management process (redrawn from Brown et al 2010 appendices).

Reference points were not modified to any significant degree in the management strategies explored in the current project. Brown et al (2012), however, explored whether modification of reference points could mitigate the effects of management delays. They found that only a doubling (or more) of the biomass target reference points (i.e. to B_{80} or higher) reduced the probability of collapse to less than 0.2. Brown et al (2012) also explored whether limits on the maximum harvest rate could compensate for the management delays across the different life history types, forms of environmental change and assessment uncertainties. They found that greater harvest limits were required with longer delays, with 5-15% of harvest lost as a result. This concurs with the finding of the current study that management is undermined if harvest can not be constrained as the system changes.

Brown et al (2012) concluded that management should be minimized to promote long-term ecological and industry persistence or instead that conservative harvest limits are required to compensate for delays in management. Brown et al (2012) also reviewed management timelines (from data collection to the implementation of management decisions) to see how these compared versus the simulated delays. They found that management delays within fisheries organisations (looking across institutes from around the globe) are pervasive. These delays have many sociopolitical, institutional, and ecological causes (which are rarely explicitly reported). The longest delays are often socially mediated, with pressure on resource managers leading to a reluctance to reduce harvest limits despite evidence of population declines. Even when this does not occur the assessment process itself can span years, from collection of data to the delivery of a recommendation and the implemented of a decision. Scientific uncertainty regarding stock status can introduce further delays as managers tend to default to requesting more information (data collection) regarding status or productivity rather than taking an action, particularly if that action would reduce catches. Thus the historical evidence is that short turn around governance systems are challenging to develop, but all the modelling work to date indicates that they are critical for long-term sustainability of fishing industries.

BALANCED HARVEST

Many of the simulations considered in this project, especially under higher emission scenarios, saw a turn over in target species and would require a change in market demand or the Australian palate to see the product consumed. This kind of shift may seem unlikely given the traditional preference of Australians for white finfish flesh. However, diets are far more diverse today than for many Australians in past generations. Moreover, the expansion of the taxa included in the new fisheries is in line with the recommendations by

Garcia et al (2012) that sustainable fisheries require a shift in the paradigm from concentrating on a small number of species to spreading pressure over a broader range of taxa, exploiting them in proportion to their relative productivity. Modelling presented in Garcia et al (2012) suggests that if technical issues associated with targeting in proportion to productivity can be solved and marketing or perception barriers to taking such broad taxonomic landings are dealt with then balanced harvesting could lead to higher absolute catches with less severe conservation outcomes than are seen with selective fishing (Figure 72).

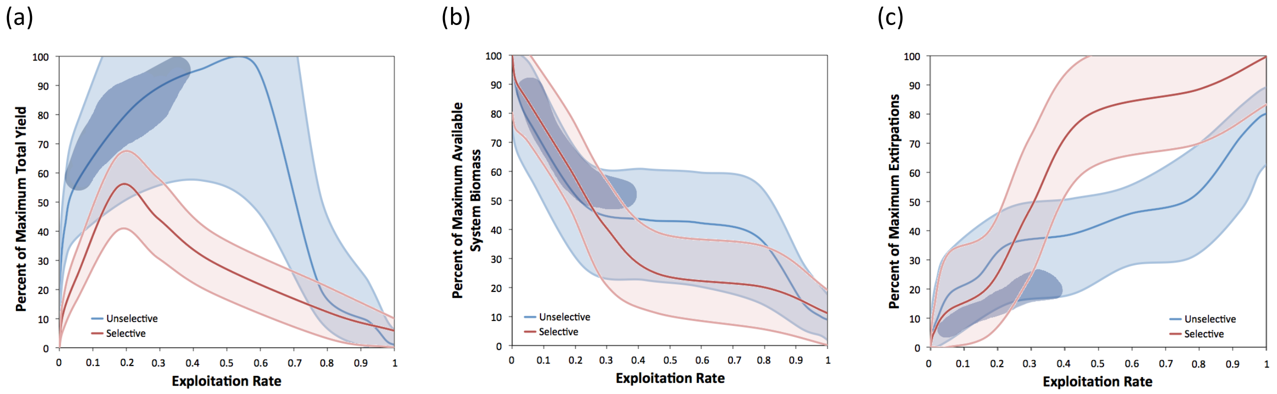


Figure 72: Relative results under conventionally selective harvesting targeting (red), unselective harvesting of all exploitable non-microfauna (blue), and balanced harvesting in proportion to productivity per biomass for each group (dark blue): (a) total landings (as a percentage of the maximum total yield for a system across all simulations); (b) total available harvestable biomass; and (c) extirpations (number of groups that have dropped below 10% of their unfished levels). Reproduced with permission from Garcia et al (2012).

Barriers to adaptation

The third objective of the project was to identify potential barriers to adaptation. The simulation work was in agreement with a broad section of the literature that indicates that, given the kinds of changes that will potentially be experience in the region in the future, there are various barriers and that many of them are simultaneously in action. As discussed further below the modelling suggested that under high emission scenarios biological barriers would be reached, but that in most cases it is the barriers within the human parts of the system that present then greatest hindrance to adaptation.

There are many ways in which global change may affect marine ecosystems. Sea-level, temperature, alkalinity, oxygen, stratification, winds, upwellings, currents, incident solar radiation, storm intensity or frequency, coastal run-off and available habitat substrates may all be modified as a result of climate change or coastal developments (Hoegh-Guldberg 2005, Hobday et al 2006, Barange et al 2010, IPCC 2014). In turn habitats, productivity, trophic linkages, biomasses and community composition could respond in a myriad of ways (Hall-Spencer et al 2008, Cheung et al 2009, Munday et al 2009, IPCC 2014). Ultimately this could present challenges for coastal communities that exploit marine ecosystems (Barange et al 2014, IPCC 2014). The ease with which societies will adapt to these changed conditions is unknown on a global stage, with some of the most vulnerable also the most exposed (Barange et al 2014). Human societies have adapted to past changes so adaptation is possible. To successful adapt in this instance, i.e. to go on sustainably exploiting Australia's southeast marine ecosystems systems, Australian communities and industries will need to adapt to the new and changing forms of the ecosystems, moderating threats and utilising new opportunities (Productivity Commission 2012).

Anything that constrains identification and evaluation of options or risks can present a barrier to adaptation. Not surprisingly potential barriers can be found throughout socioecological systems. In the context of the management of fisheries and aquaculture there are six key types of barriers to adaptation. The class most fisheries scientists find easiest to identify are biological and ecological barriers – for example when productivity shifts, or target species move away, or new species enter an ecosystem and disrupt it, or productivity may changes. The other barriers to adaptation all sit within the human realm:

- Human behavioural flexibility is a key requirement in adaptation, but is not a universal personality trait, it can also be discouraged by social or cultural rules;
- Governance and regulation can constrain behaviour and prevent the flexibility needed for adaptation; moreover, management inertia can mean that responses may be slow and may lack integration, causing economic and social hardship and lowering adaptive capacity;
- Market and other economic drivers (which often act on short time frames) may not be aligned with what is required for long term adaptation;
- Technological needs may not match with what is available, meaning that even if industries recognise the need for change it may not be possible; alternatively, current technology may encourage practices that are ultimately maladaptive;
- A lack of understanding or appropriate tools to support decision making can mean that insufficient information is available for good adaptive management.

Any one of these barriers acting in isolation could pose serious problems, but they may also work in combination, seriously challenging adaptation. Concurrent action of multiple barriers is likely in southeastern Australia where environmental conditions are changing rapidly and there is a complex mix of marine industries, jurisdictions and a relatively high population density (at least by Australian standards). In that context adaptation will need to happen within the context of ongoing economic, political, social and technological changes and environmental variability.

BIOLOGICAL AND ECOLOGICAL BARRIERS TO ADAPTATION

Fisheries and aquaculture rely on having healthy stocks. This means that amongst the most basal of potential barriers to adaptation lie with the resource. If the stocks adapt to the environmental changes, meaning ecosystems do not shows significant shifts in structure or function, then there is no pressure for change in the human components of the system. A growing volume of research suggests that environmental change can influence different life history stages in different ways. Larval stages may be relatively robust to ocean warming and acidification but older life history stages may experience growth and behavioural affects that lead to reduced rates of survivorship and fecundity (Munday et al 2008, Brierley and Kingsford 2009, Booth et al 2009, Munday et al 2009, Nilsson et al 2009, Dixon et al 2010, Donelson et al 2010, Cripps et al 2011, Dixon et al 2011, Ferrari et al 2011, Munday et al 2011, Pankhurst and Munday 2011, Simpson et al 2011, Devine et al 2012, Domenici et al 2012, Ferrari et al 2012, Nilsson et al 2012, Nowicki et al 2012, Couturier et al 2013, Chivers et al 2014, IPCC 2014, Watson et al 2014). Habitat dependent fish may be even more susceptible to climate change or ocean acidification as there are both direct physiological effects on the fish themselves as well as the habitats they use (Bonin et al 2009, Coker et al 2009, McCormick et al 2013, IPCC 2014, Munday et al 2014). Many different kinds of models predict that the outcomes of differential vulnerability and responses of fish to environmental shifts (and other socioecological drivers) are range shifts (Cheung et al 2009, Booth et al 2011) and shifting ecosystem composition to novel assemblages that have not previously been recorded together (Hannah et al 2005, Hoegh-Guldberg 2005). This has implications for the delivery of ecosystem services including fisheries and aquaculture.

As seen in some of the simulations performed here, and Brown et al (2009), shifts in primary production necessitate changes in human use. It is unlikely that there will be uniform shifts in primary production across the entire southeastern region, which means that reductions may occur in some locations and increases in other (as suggested by Matear et al 2013). This suggests that reductions in exploitation will be necessary in some locations for long-term sustainability, but equally there will be opportunities for expansion in other locations to recover depleted stocks or establish new fisheries (as seen in the spatial mosaics and distribution of new fisheries in the simulations here). This species specific mix of winners and losers is a common finding from ecosystem modelling used to explore potential futures (Brown et al 2009, Fulton 2011, Dutkiewicz et al 2013, Fulton et al 2014).

Another aspect of ecological change that can form a barrier to adaptation are nonlinear ecosystem responses. Many economics-based assessments of future change (e.g. Garnaut 2008, Commonwealth of Australia 2010, Productivity Commission 2012) assume gradual or smooth change. Humans are most comfortable with dealing with such change but find nonlinear change and feedback systems more difficult to contend with. If strong and sudden nonlinear changes occur in ecological systems then managers will find it difficult to deal with these events. The projected trajectories for southeast Australia in Fulton (2011) and in the simulations presented here indicate that demersal fish species (amongst others) may experience an extended range shift down the east coast of Australia. The mechanisms behind these shifts accrete from combinations of both slow shifts (due to generational scale range expansions) and more rapid changes to survival, physiology, dispersal and migration; many of these changes will not be smooth or linear (Frank et al 2005, Lovejoy and Hannah 2005, Brander 2007, IPCC 2014). Regime shifts are amongst the most extreme and cumulative expression of such nonlinear responses and have been anticipated by reviews of potential climate change effects (e.g. Brander, 2007, 2009, Barange et al 2010) and have previously been observed in the Benguela (Shannon et al 2008), North Atlantic (Beaugrand 2004) and North Pacific (Hare and Mantua 2000, Overland et al 2008, Tian et al 2008). Regime shifts (beyond those forced upon primary producers under some of the scenarios) were produced by some of the parameterisations of Atlantis-SE suggesting that it may be a future system feature that will present adaptation challenges.

Regime shifts are not a ubiquitous feature of all parameterisations, however the synergistic action of multiple stressors is a universal result from both Atlantis models under all scenarios and parameterisations (and has been seen in other variants of these models, Griffith et al 2011). This result agrees with what has been seen in other (particularly demersal) marine systems (Watters et al 2003, Heath 2005, Frank et al 2005, Przeslawski et al 2005, Crain et al 2008, Kaplan et al 2010). The mechanisms driving the synergisms in the models relate to truncation of the age structure of fish, shifts in relative spatial distributions and altered community compositions. These changes effect system structure, reducing interconnectedness and thus resilience (McCann 2000, Bascompte et al 2005), but also see the removal of the system's buffering capacity - as many of the groups that come to dominate under these altered states have faster life histories which lack the buffering capacity of longer lived species (Chesson and Warner 1981). While exacerbated by ocean warming and acidification these kinds of shifts are not unique to environmental shifts and have been previously encountered (in a general sense) by fisheries and conservation. This means that (at least in theory) mechanisms behind the synergistic effects, as described by the models, could be tractably addressed, to some extent, by management bodies. This provides tangible support for the intuitively appealing idea that by constraining human use may provide ecosystems with extra scope for adapting to the environmental shifts. This is a heartening outcome as familiarity with annual fisheries management cycles means they are amenable to relatively fast manipulation through management action (Cooley and Doney 2009). Consequently, good fisheries management may be sufficient to increase the resilience of marine systems (Gurevich et al 2000).

BEHAVIOURAL BARRIERS TO ADAPTATION

The action of users of the system is also an obvious place to look for barriers to adaptation. There is a substantial literature on the behavioural, cognitive and social barriers to adaptation. The breadth of mechanisms discussed in that literature is beyond what could be sensibly represented in Atlantis. It was possible to include some behavioural and psychological aspects, particularly in Atlantis-SE. This highlighted how human behaviour may facilitate or hinder adaptation. Behavioural flexibility (e.g. the willingness to update behaviour based on new information rather than rely on habits) proved to be an important feature. Both the simulations reported on here and previous work with a variant of Atlantis-SE suggested that flexible fishers benefit in the long term (van Putten et al 2013). They may have seen more year-to-year variability in the specific activities they undertake, but they achieve the greatest profitability in the long term. This kind of flexibility may increase resiliency and support adaptive capacity, but there is a good deal of uncertainty about the propensity for such flexibility (and the differential expression across individuals) and there is a history of both theoretical and empirical research on adaptation.

Adaptive capacity can be assessed at a range of scales, from the individual (Marshall and Marshall 2007), to households (Adger and Vincent 2005), communities (Adger 2000, Berkes and Seixas 2006, Cinner et al 2009) and at national scales (Adger and Vincent 2005, Nelson et al 2009). Conceptually, the capacity and resourcefulness to develop effective coping mechanisms contributes to the likelihood of adaptation (Marshall et al 2007). Empirical studies indicate that adaptation is highly context-specific (e.g. Risbey et al 1999, Wolf 2011) and is influenced by cultural traditions and attitudes, demographics, and social and economic structures. Generalisations will continue to be problematic as social components of community adaptation are difficult to separate from behavioural and cognitive aspects of individual decision-making. The social aspects of adaptation are contingent on ethics, knowledge, attitudes to risk (Adger et al 2009), perception of vulnerability and impacts, social and institutional context and capital, cultural norms and values (Adger 1999, 2003, O'Brien et al 2006, Moser and Tribbia 2007, Wolf et al 2009, Wolf 2011, Wolf et al 2011, Marshall et al 2012, Adger et al 2013).

Individual responses to change depend on individual's immediate circumstances (if they are under strain from other sources they may not have the capacity for further change; Kahneman 2011), their understanding of the situation and potential future conditions, their risk profile and personality (Productivity Commission 2012). Improved understanding of the consequences and opportunities associated with change facilitate adaptation behaviour (Boyd et al 2011), as it allows for informed choices between different adaptation options based, conditioned on perceived costs and benefits (Crowle and Turner 2010). Differential individual adaptive capacity is exacerbated by heterogeneity in the capacity to gather, process and use the information (e.g. due to a lack of skills or resources). Contrary to assumptions made by economists, people apply heuristic rules to simplify or speed up the decision making process (Reeson and Dunstall 2009), opting for 'good enough' rather than 'optimal' outcomes and sub-consciously reshaping the questions, by making mental substitutions, so that they can be answered with available information – potentially with sub-optimal or unintentional outcomes (e.g. focusing on gaining more material possessions rather than achieving happiness, Kahneman 2011). Cognitive research shows that individuals have trouble weighing up costs and benefits that occur over long timeframes and can be influenced by incidental information that has no relevance to the topic at hand (Kahneman 2011). This is why one way of improving the decision making process is to provide it with meaningful local level information (Kuruppu and Liverman 2011), it is also why experience of past and recent extreme climate events shapes perceptions of future climate (Cruikshank 2001, Huntington and Fox 2005) and so affects adaptation behaviour. Another feature of individual decision-making that acts as a barrier to adaptation is procrastination and a mishandling of timing. Preparations required on long timeframes about uncertain impacts may be repeatedly deferred (sometimes with the best of intentions, such as when arguing for more certainty before making costly decisions). This ignores the lag times common in complex systems, which mean that immediate (if uncertain) action may be necessary for outcomes to be established in timely manner (e.g. stock restoration or habitat transplantations may take decades to complete).

At a societal level significant trade-offs, and conflicting objectives, can exist between different sectors; meaning that without integration conflict can potentially arise when parties with differing incentives execute their individual adaptive strategies (Fulton et al 2011). Differential outcomes need not even be expressed within one generation either. It is a common economic assumption that future generations will be substantially wealthier than the current generation; which is in agreement with the growth in the average GDP per capita through recorded history (Maddison 2001). This economic assumption sees many proposed mitigation and adaptation strategies pass a non-trivial cost component to future generations. The assumption ignores the growing inequity in income, however (Quiggin 2010, Jaumotte et al 2013).

While there are many barriers to adaptive capacity amongst the most disadvantaged (in terms of financial, physical, societal or human capital; Allison et al 2009, Leach et al 2010) previous generations have successfully transitioned quite large societal changes. This illustrates that within limits people can manage adaptation with respect to environmental variability and structural change (Productivity Commission 2012). Whether the context of future change is analogous to historical periods that supported adaptation or better match periods where there was hardship and societal stagnation remains a topic of heated intellectual and popular debate (e.g. Piketty 2014).

GOVERNANCE AND REGULATORY BARRIERS TO ADAPTATION

The action of regulators can also present barriers to adaptation. For example, if inertia or the political process prevents action that could reduce synergistic action of multiple stressors (as was the case in the simulations here that used a slowed assessment cycle). While there is academic support for the proposition that more stringent management to reduce stress on ecosystems and give stocks more adaptive capacity (Roy and Pandolfi 2005, Hobday et al 2006, Brander 2007), there is some ideological opposition to increased regulation. Moreover, the differential impacts and opportunities observed in this study would also complicate adaptation by regulatory bodies. Individual adaptive capacity will influence the incentives of fishers and other stakeholders to comply with changing regulations (Fulton et al 2011), as will perceptions of fairness (Gilligan and Richardson 2005). Adaptation is easier if there is coherence industry wide rather than competition between individuals. Unfortunately, this unlikely to be the case for southeast Australia and so a more nuanced approach than any of the proposed strategies considered here will be required if effective, egalitarian and economically efficient management is to be assured (Eide and Heen 2002). As the existence of such an option is not guaranteed it is likely that adaption by regulatory bodies will need to navigate opposition from at least some sectors of society.

In addition governance changes will need to be on going, as the socioecological system (including features of Australian culture) will change through time, especially if the kinds of regime shifts or other large scale changes explored in this project occur. Thus recipe-book applications are unlikely to be particularly successful (Fulton et al 2014). Even addressing the technical aspects of shifting regulations will present challenges. The updating of reference points have been suggested as the best practice means of adapting current management strategies for changing climate conditions (A'mar et al 2009, Brown et al 2012), however the modified reference points will be hard to estimate given noise in monitoring data. Spatial management has been suggested as an alternative management method that is less reliant on reference levels (Steffen et al 2009) do not perform well against all objectives in this study and have their own potential barriers to adaptation. The current static form of spatial zoning used as the basis of conservation management is not well suited to the more fluid nature of future marine ecosystems. Shifting systems are likely to make some existing reserves less effective and others completely ineffectual. While this may lead to pressure to dissolve them and establish them elsewhere, rapid change is unlikely as acts of parliament are currently involved in the declaration of zones in Australia. Recognition of these limitations and the inappropriateness of static geographically defined zones for the conservation of highly mobile species means that future zones may be defined around oceanographic features rather than geographic coordinates (Hobday et al 2011).

Coordinated management over large spatial areas and across sectors is an alternative management response that may provide improved adaptive capacity (as evidenced by the improvement in management performance when considering centralised or integrated management over fragmented management in the simulations). This broader scale, cooperative approach to management is already becoming a more common principal in Australian fisheries and coastal management (e.g. the proposals for a single management council for lobster in southern Australian states; or Hannah et al 2005, McDonald et al 2006, 2008). As transition to fully integrated management has yet to happen potential barriers to adaptation lie within what could be a long process of reshaping historical jurisdictional management. It may take some time for states to see the value in coordinated stock management, which would stymy effective adaptation (Productivity Commission 2012).

Some regulatory barriers to adaptation exist in the way that rules, put in place with the best of intentions in the context of historical ecosystems and fisheries, potentially inhibit adaptive behavioural changes – either by impeding individual risk management, inappropriately blunting price signals or limiting innovation by directly curtailing activities. For example, bycatch constraints (imposed to minimise the landings of species that were traditionally a marginal component of the system) could prevent effective targeting should abundance shifts out pace regulatory processes. Barriers to the activity of companies across jurisdictions could impact cost efficiency and economic performance; and as discussed above jurisdictional complications are associated with range extensions. Similarly spatial zoning and spatially oriented access permits may constrain the ability of fishers to modify effort allocation in response to shifting species spatial distributions. Attractive features of transferable licences may decline, for instance it is unlikely that new operators will buy in to a declining market, or alternatively quota may be hard to access if it becomes a means of supporting retirement incomes (van Putten and Gardner 2010). This is not to say that sound fisheries management practices be abandoned, but recognition that nimble management will be required. It is not exactly clear as yet what would be required for nimble management operating at maximum levels of sustainable harvesting rates. It is clear that good environmental information, transparently shared, facilitates good decision-making and is fundamental to the success of co-management more generally (Pomeroy et al 2001), to date one key unifying factor in successful fisheries management approaches

(Worm et al 2009). However, if effective and nimble management requires extensive monitoring or costly management interventions it may be beyond the management's resource base given the relatively small contribution of fisheries and aquaculture to Australia's GDP (AIMS 2010).

Modification of the environment to tailor it to human needs is a feature of marine ecosystem use in some Asian nations (e.g. use of artificial reefs and structures in ocean ranching in Japan and China). On land handling of some of the life history steps was a growing feature of aquaculture in the models. However, intervention in the life history of wild caught stocks was not considered in the model simulations to date, as there was little agreement amongst the stakeholders consulted during scenario identification on what form that would take and at what scales. Such direct intervention to address short falls in life history strategies could alleviate any stage failures through restocking programs or the hatchery rearing of critical life history stages that can no longer successfully survive or arrive in the traditional locations. Such approaches have been used (e.g. in salmon fisheries) to address stock depletion due to habitat loss or overfishing (Booth et al 2009), though have seen less use in marine systems until recently when the distinction between fisheries and aquaculture began to blur (e.g. the translocation of lobsters in Tasmania to improve growth and attractiveness as a fishery resource, Chandrapavan et al 2011). While there is logic to the approach it, like other scientifically sound but interventionist approaches, may be subject to some level of social dissonance and conservation cringe (Hobday et al 2014) and so broader community based debate and consultation would be necessary before taking the idea further. Even if direct life history intervention is considered too extreme, other system modifications in support of increasing adaptive capacity may be found to be acceptable (e.g. the protection of estuarine nursery habitats, or the modification of flow regimes to enhance fecundity or migration success). Although the success of such approaches would be dependent on coordination across sectors and levels of government, as built infrastructure may prevent the retreat of crucial habitats; actions by one industry may undermine another; and competition between industries may constrain access to fishing grounds (or aquaculture habitat), ports and freight services.

ECONOMIC AND MARKET BARRIERS TO ADAPTATION

Within the Atlantis-SE simulations the greatest expression of potential economic barriers are in the form of: the availability of bycatch quota (which is typically far more constraining than quota for target species); the costs of operating (e.g. increased costs see fishing footprints contract back towards the ports); and the financial viability of the fishery under some forms of management (such as large scale spatial closures where landings are insufficient to cover onshore costs in addition to the costs incurred in fishing). Economic adaptive capacity is also greater for larger fisheries operators in the models. Existing economic information for southeast Australian fisheries, used to parameterise these Atlantis models, indicates that smallest operators are most likely to suffer detrimental effects of system-level change (Fulton et al 2007, Fulton 2011). Smaller vessels may have lower cost structures, but their operators are often more socially constrained (by life style choices and social or family commitments) and are less able to shift as quickly or completely as larger operators and can not modify their behaviour as rapidly as "captains for hire" working for large companies (Baelde 2001, Marshall et al 2007).

These behavioural constraints are one example of how economic and behavioural barriers can interact. Numerous decisions and responses made by individuals, firms and other organisations are driven by economically mediated incentives. The basic premise of the use of property rights in fisheries management is that providing financial incentives (i.e. market instruments) facilitates adaptation if it fairly signals changes in the value or scarcity of the resource (Agrawala and Fankhauser 2008). Unfortunately property rights do not always function as expected (Sumalia 2010, van Putten et al 2014), especially if non-market drivers dominate motivations, or the values are difficult to define (Costello and Deacon 2007).

If operators have sufficient financial and social (and other capital) adaptation is possible, as evidence by society's response to previous economy wide 'structural adjustments', such as trade liberalisation or the by information technology revolution (Productivity Commission 2012). It is often assumed that governments can improve adaptive capacity in such circumstances by supporting economic growth via improved efficiency and regulatory flexibility. Unfortunately a growing body of literature (particularly in the fields of of integrated assessment modelling and network analyses) indicates that this assumption is flawed, with increased efficiency typically leading to a reduction in redundancy, but increased fragility (Dalziell and

McManus 2004). In addition, feedbacks in complex socioecological systems can see actions that promote adaptation at one scale work counter to mitigation policies at other scales, or vice versa. Such cross scale interactions and potentially conflicting outcomes at different scales are common in complex systems (Kinzig et al 2006).

TECHNOLOGICAL BARRIERS TO ADAPTATION

Technological barriers to adaptation have rarely received much modelling attention. This study included a generic increase in technological efficiencies. This represents incremental improvements and small levels of innovation. It does not try to anticipate revolutionary innovations that could fundamentally change system function (equivalent to the invention of the internal combustion engine or the internet).

Incremental improvement in fisher skill due to technological advancement is often seen in fisheries, for example fishers active in southeast Australia admit to fine scale targeting of isotherms, as a means of improving targeting, has been an on water benefit of improved sensor technologies. This has improved adaptive capacity in some ways but may have reduced it in others, by changing the behaviour of fishers (as they are no longer as willing to risk gear given the cost of replacing the sensors). Similarly in aquaculture advances in technology used in culturing and grow out has a direct influence on economic viability, but also the ability of producers to tailor product and deal with weak links in the closure of life histories. Consequently, it is not inconceivable that the availability (or not) of specific technologies may have direct bearing on whether other forms of adaptation (such as behavioural or regulatory actions) are effective.

As mentioned above information availability has direct bearing on adaptive capacity. Terrestrial industries are benefiting from national databases and websites such as the Geosciences Australia flood database or the Grains Research and Development Corporation website, which targets information delivery to farmers. The SOI index is now even routinely reported in public television news broadcasts. A similar concept based around reporting on system state and short-term (seasonal to annual) forecasts or water conditions or fishable area could be of great benefit to industry operators (in fisheries and aquaculture) and regulators alike. The early stages of such information services already exist overseas (e.g. www.roffs.com) and for the aquaculture industry, which are sourcing seasonal forecasts from research organisations for the purposes of stocking and harvesting (Hobday et al 2011). At present these forecasts allow industry to identify when they need to shift timing, location or resort to onshore options. Ultimately, a day may come (e.g. for salmon producers) when it becomes clear that they may need to switch from cold-water species such as Atlantic salmon to warmer-water species (Booth et al 2009).

KNOWLEDGE BARRIERS TO ADAPTATION

The successful use of information technology to deliver to industry and managers is reliant on having information to communicate. As is obvious from the degree of variability seen in the modelling work here, significant uncertainty remains pertaining to physical, biological, economic and social aspects of the southeast marine system. There are many potential mechanisms through which climate drivers and ocean acidification can effect the function of marine systems, many of which have only been realised in the last decade (Fussmann et al 2007, Kinnison and Hairston 2007, Munday et al 2008, Bailey et al 2009, Donelson et al 2011, Ferrari et al 2011, Donelson et al 2012, Coker et al 2012, Donelson and Munday 2012, 2014). Many more will likely be identified by future research efforts. Even when mechanisms are presently known, there is a lack of empirical data regarding the importance or magnitude of them for many taxa (Griffiths et al 2011). The problem is more serious still when trying to identify and incorporate drivers and mechanisms for the anthropogenic sub-systems – which is likely why past model based analyses (e.g. Garnaut 2008, Commonwealth of Australia 2010, Productivity Commission 2012) have treated fisheries and aquaculture exceptionally simply (if they were considered at all, most integrated assessments only explicitly include terrestrial industries and options[5]). While psychological research, behavioural economy and surveys are being to unravel motivations and responses (Spence and Pidgeon 2009, Kahan et al 2012, Marshall et al

[5] Even consideration of energy options ignored the potential provided by ocean renewables. With the modelled renewables sector primarily focused on wind, solar and geothermal (Commonwealth of Australia 2010). Coastal wind farms were included in a minimalist way, but other sources such as tidal and marine biofuels were omitted.

2012, Agder et al 2013), few modelling studies address transformational adaptive change. Those behavioural models that do exist typically use an agent based modelling approach and focus on individuals or small groups (Janssen and Ostrom 2006) and rarely address institutional change. This uncertainty can, in its own right, act as a barrier to effective decision-making. Furthermore, it can make it hard to advise on the relative strength of barriers to adaptation active in the system.

Ecosystem level projections of the effects of climate change are a relatively new endeavour. Previously, the majority of projections had focused on changes in primary productivity or bioeonvelope-based shifts in the distribution and abundance of single species or closely linked groups (Cheung et al 2009, Ito et al 2010). Regional scale and global models are becoming more common now, but the work presented here still represents one of the first such efforts globally and is the first trophic whole-of-system ecosystem model to consider environmental and development drivers, multiple industries as well as evolution and acclimation (e.g. via phenotypic plasticity). As such it can provide useful insights, but will be subject to future refinement.

Knowledge gaps are a problem both for strategic modelling and tactical decision-making. Australia lacks baseline information on interannual variability long-term trends for most fished stocks. There have been efforts to supplement early research efforts (e.g. Last et al 2011) with citizen science initiatives like Redmap (www.redmap.org.au). Nonetheless data on recent population shifts of commercial species remains limited (Booth et al 2009) and will likely remain so given logistical constraints on fisheries independent surveys and broad scale monitoring. The Integrated Marine Observing System (IMOS) is discussing how to redress this, but there is still no consensus on what should be monitored (Hayes et al in review) and ecological monitoring is a long way from the sensor capability available to physical oceanographers. Even where a species life history is amenable to laboratory experiments, little is known about the early life history stages of many key commercial species and how they will respond to changed conditions, even less is known for other components of the system (such as pathogens, which may have a dramatic effect on system dynamics, as seen in *Crassostrea virginica* in Delware Bay; Brander 2006), especially large bodied top predators which cannot be easily experimentally manipulated. Models can help identify gaps and generate hypotheses around system responses. Such information can help to some extent, but there still needs to be some level of verification in reality before such information can be relied upon as a reliable source of information in the decision making process.

MODEL RESULTS – MOST COMMON BARRIERS TO ADAPTATION

The results of both models indicate that up to a point (at around 550+ ppm atmospheric pCO_2) ecological systems have sufficient adaptive capacity to ensure that there are not substantial shifts or deterioration in functional diversity or system structure. Many of the components of the southeastern marine shelf-to-offshore ecosystems may shift in abundance or spatial distribution, but the majority of those shifts won't be substantial to the point of completely reshaping the general form of the ecosystems. This is because biological adaptation (via acclimation or evolution) is sufficiently rapid that by 2070 the ecological groups have proven to be fairly resilient to the magnitude of change seen. This is not the case under more extreme emissions scenarios where ecological rates of change, especially for demersal species, may be overwhelmed (at least based on current understanding).

Both before and after the modelled ecosystems reached these potential bifurcation points, the greatest barriers to change seem embedded in the human components of the system. Under the more moderate scenarios this is not expressed particularly deleteriously, as the biological shifts are either not extreme or are only spatially constrained. Although even then the responsiveness of the operators is conditional on market changes allowing for the shifting relative composition of catch and availability of some of the species that are currently key commercial or recreational species.

Under the extreme emission scenarios human attitudes, inflexibility and market forces can interact with the biological changes to lead to more extreme outcomes. If the fisher behaviour, or management regime, is inflexible then even if the species shift to cope with the environmental forcing then the fisher cannot keep pace and there is economic hardship. With flexible, integrated and central management this hardship can be eased by allowing matching spatial shifts (though these may in turn be prevented by social constraints as it is not easy to switch home ports, especially for operators of small to moderately sized boats) or by allowing more flexible targeting. To do this successfully, management will need to show more integration across Australia or develop frameworks that deal with range extensions, contractions or regime shifts. Such management measures are beginning to be seen in Victoria (da Silva pers com) and federally (Wayte 2013). As with ecosystem-based management in general (Fulton et al 2007, Worm et al 2009), there will be no simple or single management solution that will solve climate change management issues. Instead adaptive management processes that use science and updating information sources to support continuous revision and implementation of the management processes and changes in social and individual attitudes are likely to the best way forward (Adger et al 2005, Fulton et al 2011) given the changing economic, political, social and technological context and environmental variability that will characterise future states of southeastern Australia.

Monitoring and attribution

The fourth objective of the project was to determine how to detect significant attribute changes to inform a management response again in the face of considerable on-going uncertainty. As regulatory bodies Australia wide are operating in the context of constrained budgets and IMOS is still exploring ecological monitoring options, the stakeholders did not define monitoring schemes for testing. Instead sampling schemes were based on those explored in Smith et al (2011).

The system descriptions provided by the simulated monitoring schemes explored in this project led to significant improvements over ad hoc decision making under the various management strategies so long as the data streams were not excessively noisy. This work reinforced the findings of previous work on indicators that showed that the complex nature of ecosystem responses means that suites of indicators will be required for understanding ecosystem shifts and inferring the role of fisheries and environmental drivers (Fulton et al 2005, Link et al 2010). These indicators should cover key facets of the ecosystem – physical water column properties, primary producers or at least plankton fields, target species, habitat forming species and top predators, landings, discards, prices and employment statistics. Aggregate indices (combined using simple scoring, multicriteria decision analysis or hyperdimensional statistical procedures) are increasingly preferred in the ecological indicator literature as they integrate information (Shin et al 2012). Such approaches can be sensitive to the methods used however, and Fulton et al (2005) found that transparency and explicit understanding can be lost if using these indices (as it is not clear what is driving the response) and that performance of such aggregate measures can be poor if the data is difficult to collect, or if model formulation is difficult.

The simulation results also reinforced the findings of Smith et al (2011b) that monitoring itself will be a challenging and adaptive process – as schemes representative of strata under current conditions will not necessarily remain so indefinitely. Similarly indicator species may need to shift through time as relative abundance and community composition shifts. This means that redundancy in monitoring schemes should be encouraged (so that at least some species have continuity through the time series), but also that the monitoring should be periodically reviewed so that the required shifts can be done in a structured way. In addition, even if management is not centralised, sharing of information across jurisdictions is of significant benefit.

Conclusion

Cumulative human pressure on the Earth's systems is changing marine and coastal systems in significant ways – shifting temperature, water levels, winds, currents, stratification, oxygen concentrations, nutrient availability, extreme events and the distribution and abundance of habitats, flora and fauna. For industries, such as fisheries and aquaculture, and societies who rely on marine resources, to remain viable despite the changes they will need to adapt to change and uncertainty, as they have adapted to many other changes through time. This project used end-to-end (whole-of-system) ecosystem models to help understand both the form of potential changes, but also potentially resilient adaptation and management options.

Simulation models, such as Atlantis, that consider many of the interacting components of socio-ecological systems can be a useful tool for synthesising information, clarifying system understanding, laying out potential outcomes and highlighting contradictory, uncertain or missing information. In this instance, the Atlantis models suggested that all six types of potential barriers to adaptation (listed below) were active in southeast Australia, with the anthropogenic ones potentially posing the greatest challenges.

- Biological and ecological barriers to adaptation, such as shifts in primary productivity, or changing abundance and spatial distribution of species may change substantially, disrupting the ecosystem;
- Fisher behavioural barriers to adaptation are driven by personality and many forms of capital, together they mean that not all fishers have equal flexibility to respond and adapt, with the smaller operators apparently the least able to cope;
- Governance and regulatory barriers to adaptation may be minimised under sound sustainable adaptive management (and can support a transformational change), but features of the regulatory system may still inhibit adaptation, either via allowing fisheries to synergistically interact with environmental change to exacerbate ecological shifts, or by imposing delays in the management system, or by promoting strategies that cause economic and social hardship lowering adaptive capacity;
- Economic and market related barriers to adaptation may be confounded by social drivers, or may be shaped by short term drivers which can act counter to what is required for long term adaptation;
- Technological barriers to adaptation exist if technologies needed to change targeting or other behaviours do not exist, or if current technology encourages behaviours or system changes that are maladaptive;
- Knowledge based barriers to adaptation can undermine adaptive management and system understanding, which is reliant on quality information, this means uncertainty, insufficient information or poor communication can hinder decision making and stall adaptation.

Across the range of management strategies, parameterisation and potential emissions scenarios employed there is a non-linear relationship with biodiversity and socioeconomic state, with a threshold point occurring around 550-560ppm of atmospheric pCO_2e. Prior to this point the ecosystem components are largely biologically capable of adapting, meaning that associated socioeconomic impacts of changes in target species and their food webs is less than the extremes suggested by taxonomically based exposure assessments. However, beyond 550ppm biological adaptation and acclimation appears to be overwhelmed, with species relying on spatial range shifts as the major coping mechanism – ultimately potentially running out of shelf habitat in the 2070s. This level of change can express itself in regime shifts, particularly off Eastern Bass Strait resulting in a significant shift in productivity and system structure – often favouring cephalopods and other pelagic fast growing, small bodied species. Chondrichthyans also often perform well, but this may be a model artefact as little is known of their likely responses to environmental shifts.

Significant social, market and industry adaptation is required to remain viable through such trying times. For example, seafood markets may need to be much more diverse in 2050-2070. This is exemplifies the finding that across all the alternative emission scenarios, the greatest barriers to adaptation are within the human components of the modelled system - in the fisher behaviour, markets and governance. The response of the fishing fleets (defined by gear, vessel type and targeting) is dependent on the management strategy in place in combination with system productivity rather than to the environmental changes alone; depending on the exact behavioural responses it can also undermine management intent. Overall integrated management has the most consistent and balanced performance relative to conservation, industry and economic objectives. Specific management options (such as extensive spatial management) can out perform integrated management for a sub-set of objectives, but at the expense of performance in terms of other objectives. The synergistic action of changes in ocean temperature, ocean acidification and human use on southeast Australian marine ecosystems supports previous suggestions that effective resource management is an effective means of providing ecosystems with an improved capacity for adaptation. For example, in offshore systems paying careful attention to the management of mesopelagic species may provide greater than expected returns in protecting the food web from both direct and indirect synergistic effects of fishing and climate change on predator-prey relationships.

While integrated adaptive management across all sectors active on the shelf and in the coastal zone leads to the most robust system state, some of the required regulatory and industry shifts are currently unpalatable to at least some segments of Australian society. For instance, the simulations showed that effective management is required across fisheries; this would require more stringent regulation of recreational fishing (which is effectively open access at present). Simulations also indicated that smaller boats that were socially tied to a specific geographic region (and port) were economically vulnerable to the loss of target species, but also ecologically damaging. This is because they caused more localised depletions, as they were forced to rely on nearby (and potentially marginal) stocks instead of being able to shift to the location of the most robust stocks. This means that either the society at large would need to be carefully led through why larger vessels are required (and can be used sustainably), so as to avoid the kind of controversy seen in 2013 around the potential use of a “super trawler”. Alternatively, industry or government restructuring and resettlement plans would be periodically required to relocate and refit the vessels according to new ecological states. Inertia in the management system (e.g. lags in multi-year assessments) and industry responses have serious implications for stock status and harvest volatility when system productivity is changing.

Lastly, a word of caution. System models can be useful learning tools. Such models can appear complex and some have argued they are overly complex to interpret. It is perhaps more important to stress that they are the mathematical equivalents of cartoons of the system; useful caricatures but not a crystal ball. They can provide ideas around challenges that alternative futures may hold, but they are unlikely to predict the exact form any one future will take.

Implications

As outlined in the discussion of barriers to adaptation, this project highlights that southeastern Australian marine and coastal ecosystems may face many different barriers to adaptation. The majority of these are likely to sit within the human components of the system. In particular it will be important to find a navigable and no regrets pathway to adaptive integrated management across sectors.

If this information can accessed (e.g. via **sea**view) and can be used to inform future management decisions then it has the potential to help shape sustainable futures for the region – just as the analyses done by Smith et al (2009) helped inform the restructuring, and support the sustainability, of the Southern and Eastern Scalefish and Shark Fishery.

Recommendations, Extension and Adoption

One of the key steps to making sure that maximum benefit is gained from the modelling work and the SEAP body of work more broadly is to make sure it is broadly disseminated. To that end the seaview website will be updated so that it contains the Atlantis-SE and Atlantis-SEAP. In addition, the SEAP section of seaview will be cross connected with the Redmap website and the SEAP factsheets. Additional fact sheets focusing on the output of this and other recently completed SEAP projects will also be created and uploaded to these websites. Simple animations could also be done to communicate the major findings from the work in a simple form. A couple of animations are already under development and will be posted to the **sea**view website, but there is plenty of scope for future targeted projects to create a larger library of animations for communication purposes. Given the sensitivity of the system to barriers to adaptation associated with human responses, education around potential changes and adaptation strategies (across all parts of society) are very important if maladaptive responses are to be avoided.

This online hosting of the model (and other SEAP) results is the major way in which the project is being communicated with potential end users. Multiple workshops have been held through the life of the project, which have had positive responses. These have not only elicited options from the stakeholders, but have been a route for communicating earlier findings and stressing the role of the website in sharing final results. Once the animations and factsheets are complete a mail out (and phone calls) to all previous workshop participants and relevant regulatory and industry bodies will be used to highlight the release of the final results. The research team have been invited to present to relevant management bodies (and are willing to do so at the convenience of those bodies). One paper focusing on the Atlantis-SE simulations is already in review with a leading journal (media coverage may accompany the release of this paper if accepted), with other papers in preparation. In addition, contributions by team members to related research work on system state and potential responses (used as a preparatory stage for the main simulation work) has already seen 5 papers published in the scientific literature (included in the appendices for reference).

Looking to the next logical steps on the back of this work, there is a serious need to try and reduce some of the uncertainty evident in the broad range of possible outcomes under some parameterisations. First, improved understanding of responses of species from southeast Australia, especially large-bodied species like sharks (etc.) needs to be gained as rapidly as possible to determine which species are most likely to be impacted in future and where management attention is most needed. While smaller animals may be handled in aquaria, the larger bodied animals will be more challenging and may require either by caged experiments near natural seeps or treatments in mesocosms or aquaculture facilities.

Species likely to experience life histories when drawn out across the shelf systems of southeast Australia need to be identified, as do the potential source-sink locations. Scientifically there is also a need for more dedicated modelling tools targeting the question (e.g. Lagarangian larval and connectivity models), which would be required to explore these issues in more depth.

Beyond biological understanding there would be significant benefit in initiating discussions around what an operationalized form of integrated adaptive management (across all users of the marine and coastal environments) would look like. In the model simulations this management approach was the most effective means of maintaining sustainable, desirable and productive marine ecosystems under all levels of global change. There will be many more surprises still to come and flexibility to respond in a timely manner is critical. Centralised or cooperative management arrangements (where management jurisdiction matches species extent) have been identified here as an effective means of retaining sustainability and cost effective management as species distributions shift. Such an approach helps avoid “lock-in” to increasingly prescriptive management actions driven by climate change associated distributional shifts (which may erroneous be interpreted as overfishing in more poleward jurisdictions). While it is relatively easy to handle allocations within a model in reality new means of allocating costs and sharing benefits as “source” and “sink” locations will be required, many other aspects of practical integrated management will also need dedicated discussion by relevant groups.

As stated repeatedly above, good decision-making is reliant on good information. Fisheries dependent monitoring can indicate, to some extent, shifts in distribution and system status (if confounding market shifts can be accounted for it may even be possible to detect regime shifts form variability of catches). However, sustained ocean observing, not just of physical properties but ecological components (spanning primary production, habitats, fish and higher trophic levels) is the most reliable means of detecting and attributing climate change in a timely manner. There are significant logistic costs associated with such exercises at large scale regional or national scales and best use of technology would be critical for being able to support such efforts long term. The cost is offset (or negated) however, by avoiding costs to regulators and industry associated with cascading management responses required under current legislation when the cause of changes in stock status is uncertain. Further research both on the technical monitoring side of things and cost benefit analysis of avoided future costs would be useful for future management planning.

Finally, the work to date has largely occurred assuming a global context not substantially different in effect to today (e.g. there is a global demand for Australian fish product, global fuel and aquaculture feed markets exist etc.). An assessment of Australia’s vulnerability to being shut out of world markets, and the local effects of such an eventuality, would be important for rounding out this assessment of potential futures for Australia’s southeastern fisheries. With the rise in economic power of India, China, Brazil (etc.) and the changing magnitude of world market flows it cannot be assumed that Australia’s production and demand will be serviced in the same way as today. This is already being seen in pharmaceuticals and the manufacturing industries so it would be apposite for fisheries too.

Project materials developed

Four published papers were developed in association with this project (via a collaboration between project team members and Gary Griffith and Christopher Brown):

Brown CJ, Fulton EA, Possingham HP and Richardson AJ (2012) How long can fisheries managers afford to delay action on climate change? *Ecological Applications* 22:298–310.

Brown CJ, Fulton EA, Hobday AJ, Matear R, Possingham HP, Bulman C, Christensen V, Forrest RE, Gehrke PC, Gribble NA, Griffiths SP, Lozano-Montes H, Martin JM, Metcalf S, Okey TA, Watson R and Richardson AJ (2009) Ecological interactions within marine ecosystems determine winners and losers under climate change. *Global Change Biology* doi: 10.1111/j.1365-2486.2009.02046.x

Griffith GP, Fulton EA and Richardson AJ (2011) Effects of fishing and acidification-related benthic mortality on the southeast Australian marine ecosystem. *Global Change Biology* 17:3058-3074

Griffith GP, Richardson AJ, Fulton EA and Gorton R. (2012) Evaluating the interaction effects of Ocean Warming, Ocean Acidification and Fisheries. *Conservation Biology* 6: 1145-52.

With two more papers are in review:

Griffith GP, Fulton EA, Strutton P, Semmens J and Vennell R (in review) Identifying key species from the complex interaction effects of human impacts on marine systems.

Fulton EA, Johnson P, Griffith G, Gorton R, Audzijonyte A (in review) Facing Colliding Barriers to Marine and Coastal Adaptation.

All but the last of the listed papers were joint collaborations extending beyond the SEAP program. The work by Gary Griffith was supported by an Australian Research Council grant DI0882986; and the work by Christopher Brown was supported by a University of Queensland Graduate Research Scholarship, a CSIRO Climate Adaptation Scholarship, an Australian Research Council Discovery Grant DP0879365 – with contributions by AJ Richardson supported by the Australian Research Council Future Fellowship Grant FT0991722 and those of TA Okey by the Pew Fellows Program in Marine Conservation. The ETBF Ecosim model used by Brown et al (2009) was developed under the Fisheries Research and Development Corporation project 2004/063.

Appendix A – Supplementary Results

Atlantis-SE

Table A. 1: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SE for each strategy-scenario combination under RCP 3. Biomass is relative to 2010 model values.

Scenario -	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	1.53 (± 0.47)	17.82 (± 23.26)	1.34 (± 1.46)	1.25 (± 0.82)	2.19 (± 1.39)	1.3 (± 0.42)	1.96 (± 1.75)
2010 coastal context - Cap ecosystem take	1.49 (± 0.41)	5.07 (± 3.48)	0.64 (± 0.75)	0.03 (± 0.02)	0.1 (± 0.06)	0.7 (± 0.04)	4.04 (± 1.32)
2010 coastal context - Centralised mgmt.	1.73 (± 0.02)	7.35 (± 7.69)	0.64 (± 0.74)	0.05 (± 0.03)	0.17 (± 0.08)	1.31 (± 0.4)	5.15 (± 1.23)
2010 coastal context - FewMPA	1.65 (± 0.08)	5.16 (± 3.39)	0.6 (± 0.76)	0 (± 0)	0 (± 0)	0.26 (± 0.02)	2.79 (± 0.13)
2010 coastal context - Fragmented mgmt	1.73 (± 0.01)	7.18 (± 7.02)	0.66 (± 0.78)	0.03 (± 0.03)	0.14 (± 0.13)	0.48 (± 0.07)	4.81 (± 1.61)
2010 coastal context - ManyMPA	1.72 (± 0.01)	2.78 (± 2.34)	0.35 (± 0.41)	1.5 (± 0.1)	1.85 (± 0.03)	1.4 (± 0.45)	1.36 (± 0.06)
2010 coastal context - Seasons	1.72 (± 0.02)	2.91 (± 2.65)	0.36 (± 0.41)	1.39 (± 0.16)	1.94 (± 0.24)	1.38 (± 0.47)	1.72 (± 0.4)
2010 coastal context - SlowAssess	1.74 (± 0.02)	7.7 (± 8.89)	0.58 (± 0.65)	0.33 (± 0.53)	0.53 (± 0.66)	0.48 (± 0.17)	5.05 (± 1.57)
2010 coastal context - Integrated Mgmt (IM)	1.2 (± 0.64)	7.29 (± 4.37)	0.24 (± 0.28)	3.17 (± 3.26)	1.59 (± 0.55)	2.1 (± 1.45)	1.17 (± 0.96)
Cumulative impacts - 2010 Status Quo (SQ)	1.71 (± 0.03)	10.62 (± 8.62)	0.65 (± 0.82)	0 (± 0)	0 (± 0)	0.09 (± 0.01)	3.5 (± 0.7)
Cumulative impacts - Cap ecosystem take	1.49 (± 0.42)	8.21 (± 4.54)	0.65 (± 0.82)	0 (± 0)	0 (± 0)	0.06 (± 0.02)	3.25 (± 0.69)
Cumulative impacts - Centralised mgmt.	1.72 (± 0.03)	11.36 (± 9.91)	0.64 (± 0.81)	0 (± 0)	0 (± 0)	0.1 (± 0)	4.19 (± 0.82)
Cumulative impacts - FewMPA	1.64 (± 0.1)	9.19 (± 6.22)	0.61 (± 0.82)	0 (± 0)	0 (± 0)	0.02 (± 0.01)	2.3 (± 0.29)
Cumulative impacts - Fragmented mgmt	1.72 (± 0.02)	11.21 (± 9.01)	0.67 (± 0.85)	0 (± 0)	0 (± 0)	0.04 (± 0.01)	3.88 (± 1.06)
Cumulative impacts - ManyMPA	1.71 (± 0.02)	4.3 (± 2.93)	0.36 (± 0.45)	0 (± 0)	0 (± 0)	0.11 (± 0.02)	1.12 (± 0.19)
Cumulative impacts - Seasons	1.71 (± 0.03)	4.62 (± 3.41)	0.36 (± 0.45)	0 (± 0)	0 (± 0)	0.11 (± 0.02)	1.39 (± 0.14)
Cumulative impacts - SlowAssess	1.73 (± 0.05)	11.31 (± 11.66)	0.58 (± 0.7)	0 (± 0)	0 (± 0)	0.04 (± 0.03)	4.08 (± 1.03)
Cumulative impacts - IM	1.19 (± 0.63)	12.08 (± 6.22)	0.24 (± 0.3)	0 (± 0)	0 (± 0)	0.2 (± 0.17)	0.92 (± 0.68)
Expanded LTL fishery - IM	1.74 (± 0.01)	7.5 (± 7.73)	0.62 (± 0.72)	0.11 (± 0.06)	0.31 (± 0.12)	0.63 (± 0.33)	5.17 (± 1.89)
New mesopelgic fishery - IM	1.74 (± 0.01)	7.69 (± 7.57)	0.64 (± 0.75)	0.25 (± 0.28)	0.32 (± 0.11)	0.14 (± 0.12)	5.49 (± 1.33)
Extreme climate events - IM	1.73 (± 0.01)	6.83 (± 6.39)	0.66 (± 0.77)	0.02 (± 0.02)	0.07 (± 0.03)	0.49 (± 0.26)	4.58 (± 1.19)
Blooms - IM	1.72 (± 0.01)	7.24 (± 7.22)	0.66 (± 0.78)	0.01 (± 0)	0.08 (± 0.06)	1.15 (± 0.21)	4.68 (± 1.5)

Scenario -	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
Primary production regime shift - IM	1.74 (± 0.04)	6.81 (± 6.65)	0.65 (± 0.77)	0.2 (± 0.33)	0.32 (± 0.46)	0.57 (± 0.12)	5.04 (± 1.88)
Fish kills - IM	1.73 (± 0.01)	6.81 (± 6.73)	0.65 (± 0.76)	0.01 (± 0.01)	0.08 (± 0.04)	0.45 (± 0.28)	4.39 (± 1.25)
Range extensions - IM	1.72 (± 0.03)	6.9 (± 7.55)	0.64 (± 0.75)	0.01 (± 0.01)	0.13 (± 0.04)	0.65 (± 0.18)	4.94 (± 1.23)
Gear switching allowed - IM	1.71 (± 0.02)	3.52 (± 3.64)	0.35 (± 0.4)	1.42 (± 0.06)	1.57 (± 0.27)	1.35 (± 0.46)	2.05 (± 0.37)
High compliance - IM	1.73 (± 0.01)	7.36 (± 7.17)	0.63 (± 0.74)	0.06 (± 0.05)	0.16 (± 0.16)	1.13 (± 0.29)	4.54 (± 1.52)
Low Compliance - IM	1.74 (± 0.02)	10.8 (± 12.36)	0.68 (± 0.8)	0 (± 0)	0.04 (± 0.04)	1.06 (± 0.32)	5.58 (± 2.5)
Flexible fisher behaviour - IM	1.66 (± 0.01)	6.84 (± 6.71)	0.58 (± 0.68)	0.07 (± 0.02)	0.22 (± 0.08)	0.29 (± 0.38)	5.14 (± 1.34)
Increased fishing pressure drivers - IM	1.72 (± 0.01)	6.82 (± 6.72)	0.65 (± 0.75)	0.02 (± 0.02)	0.07 (± 0.01)	1.01 (± 0.33)	4.32 (± 1.12)
High Cost, Low Values - IM	1.72 (± 0.01)	3.42 (± 3.42)	0.35 (± 0.41)	1.42 (± 0.15)	2.03 (± 0.25)	1.41 (± 0.5)	1.46 (± 0.38)
Low Costs, High Values - IM	1.26 (± 0.82)	3.31 (± 0.31)	0.64 (± 0.75)	0.04 (± 0.02)	0.14 (± 0.11)	0.18 (± 0.04)	3.76 (± 2.54)
Standard Markets - IM	1.72 (± 0.01)	6.82 (± 6.72)	0.65 (± 0.75)	0.02 (± 0.02)	0.07 (± 0.01)	1.03 (± 0.24)	4.32 (± 1.12)
Technology Creep - IM	1.7 (± 0.02)	6.38 (± 6.93)	0.48 (± 0.52)	0.8 (± 0.29)	1.14 (± 0.33)	0.2 (± 0.14)	5.09 (± 1.73)
No Acclimation - 2010 coastal context - IM	0.76 (± 0.51)	2.2 (± 0.58)	0.4 (± 0.48)	0.01 (± 0.01)	0.04 (± 0.04)	0.48 (± 0.38)	2.58 (± 2.34)
No Acclimation - Cumulative impacts - SQ	1.05 (± 0.61)	2.31 (± 0.56)	1.14 (± 1.41)	0 (± 0)	0 (± 0)	0.19 (± 0.16)	11.86 (± 7.65)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	1.06 (± 0.59)	2.65 (± 2.04)	1.58 (± 1.02)	4.81 (± 6.1)	1.68 (± 0.26)	2.04 (± 2.54)	1.03 (± 0.5)	2.1 (± 2.52)
2010 coastal context - Cap ecosystem take	0.82 (± 0.33)	3.75 (± 0.79)	1.12 (± 1.38)	0.65 (± 0.29)	1.03 (± 0.31)	0.65 (± 0.11)	0.56 (± 0.57)	0.32 (± 0.33)
2010 coastal context - Centralised mgmt.	0.92 (± 0.17)	4.56 (± 2.32)	0.54 (± 0.28)	0.72 (± 0.27)	1.17 (± 0.1)	0.79 (± 0.11)	0.63 (± 0.68)	0.59 (± 0.39)
2010 coastal context - FewMPA	0.85 (± 0.16)	4.08 (± 1.37)	0.06 (± 0.05)	0.13 (± 0.1)	1.27 (± 0.1)	0.23 (± 0.05)	0.41 (± 0.34)	0.23 (± 0.26)
2010 coastal context - Fragmented mgmt	0.91 (± 0.18)	4.45 (± 2.84)	0.47 (± 0.44)	0.67 (± 0.23)	1.17 (± 0.1)	0.75 (± 0.11)	0.54 (± 0.68)	0.31 (± 0.29)
2010 coastal context - ManyMPA	0.95 (± 0.19)	2.47 (± 2.19)	5.66 (± 4.81)	0.88 (± 0.25)	1 (± 0.09)	0.95 (± 0.16)	0.04 (± 0.02)	1.25 (± 0.88)
2010 coastal context - Seasons	0.92 (± 0.18)	3.02 (± 2.74)	5.75 (± 5.11)	0.87 (± 0.22)	1.02 (± 0.11)	0.98 (± 0.2)	0.3 (± 0.36)	0.89 (± 0.37)
2010 coastal context - SlowAssess	0.93 (± 0.17)	4.11 (± 1.96)	0.61 (± 0.48)	0.7 (± 0.33)	1.17 (± 0.1)	0.8 (± 0.11)	0.72 (± 0.73)	0.48 (± 0.34)
2010 coastal context - Integrated Mgmt (IM)	0.73 (± 0.57)	1.04 (± 0.5)	12.6 (± 14.04)	0.84 (± 0.74)	1.57 (± 0.67)	0.84 (± 0.45)	0.33 (± 0.19)	0.86 (± 0.63)
Cumulative impacts - 2010 Status Quo (SQ)	0.87 (± 0.18)	4.91 (± 2.59)	0.91 (± 1.26)	0 (± 0)	1.25 (± 0.12)	0.25 (± 0.05)	0.66 (± 0.78)	0.27 (± 0.26)
Cumulative impacts - Cap ecosystem take	0.77 (± 0.32)	3.55 (± 1.01)	11.75 (± 19.52)	0 (± 0)	1.11 (± 0.35)	0.22 (± 0.02)	0.85 (± 0.92)	0.24 (± 0.3)
Cumulative impacts - Centralised mgmt.	0.87 (± 0.18)	3.89 (± 0.03)	2.71 (± 3.56)	0 (± 0)	1.26 (± 0.12)	0.27 (± 0.05)	0.95 (± 1.1)	0.41 (± 0.36)
Cumulative impacts - FewMPA	0.81 (± 0.21)	4.12 (± 2.64)	0.35 (± 0.47)	0 (± 0)	1.36 (± 0.12)	0.08 (± 0.02)	0.63 (± 0.55)	0.24 (± 0.2)
Cumulative impacts - Fragmented mgmt	0.86 (± 0.19)	3.61 (± 0.61)	2.18 (± 2.74)	0 (± 0)	1.26 (± 0.12)	0.26 (± 0.06)	0.81 (± 1.1)	0.31 (± 0.27)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
Cumulative impacts - ManyMPA	0.89 (± 0.2)	2.1 (± 1.38)	46.06 (± 77.29)	0 (± 0)	1.08 (± 0.11)	0.33 (± 0.08)	0.05 (± 0.04)	0.75 (± 0.58)
Cumulative impacts - Seasons	0.87 (± 0.19)	2.57 (± 1.72)	48.35 (± 81.37)	0 (± 0)	1.1 (± 0.12)	0.34 (± 0.09)	0.46 (± 0.57)	0.47 (± 0.38)
Cumulative impacts - SlowAssess	0.87 (± 0.19)	3.57 (± 0.24)	0.79 (± 0.48)	0 (± 0)	1.26 (± 0.12)	0.28 (± 0.04)	1.09 (± 1.18)	0.32 (± 0.35)
Cumulative impacts - IM	0.71 (± 0.61)	1.15 (± 0.44)	120.4 (± 204.79)	0 (± 0)	1.69 (± 0.74)	0.3 (± 0.18)	0.45 (± 0.39)	0.82 (± 0.66)
Expanded LTL fishery - IM	0.92 (± 0.17)	2.84 (± 0.76)	3.69 (± 4.6)	0.77 (± 0.25)	1.18 (± 0.11)	0.82 (± 0.13)	0.65 (± 0.74)	0.65 (± 0.46)
New mesopelgic fishery - IM	0.91 (± 0.17)	2.63 (± 1.11)	1.29 (± 0.41)	0.89 (± 0.41)	1.17 (± 0.11)	0.84 (± 0.13)	0.59 (± 0.77)	0.58 (± 0.4)
Extreme climate events - IM	0.93 (± 0.18)	3.46 (± 1.23)	0.21 (± 0.19)	0.63 (± 0.25)	1.16 (± 0.11)	0.74 (± 0.14)	0.48 (± 0.55)	0.42 (± 0.4)
Blooms - IM	0.92 (± 0.15)	3.37 (± 1.22)	0.23 (± 0.24)	0.61 (± 0.17)	1.16 (± 0.11)	0.73 (± 0.15)	0.45 (± 0.53)	0.44 (± 0.45)
Primary production regime shift - IM	0.9 (± 0.16)	3.52 (± 1.35)	1.52 (± 2.33)	0.69 (± 0.29)	1.16 (± 0.11)	0.77 (± 0.07)	0.64 (± 0.83)	0.69 (± 0.94)
Fish kills - IM	0.93 (± 0.17)	3.57 (± 1.42)	0.19 (± 0.08)	0.63 (± 0.26)	1.17 (± 0.11)	0.73 (± 0.11)	0.48 (± 0.54)	0.44 (± 0.55)
Range extensions - IM	0.89 (± 0.15)	4.17 (± 0.21)	0.87 (± 0.94)	0.6 (± 0.14)	1.19 (± 0.1)	0.69 (± 0.2)	0.75 (± 0.61)	0.36 (± 0.27)
Gear switching allowed - IM	0.93 (± 0.17)	3.12 (± 0.22)	5.5 (± 4.87)	0.84 (± 0.22)	1.04 (± 0.11)	0.94 (± 0.18)	0.91 (± 0.84)	1.05 (± 0.68)
High compliance - IM	0.92 (± 0.18)	3.18 (± 1.62)	1.18 (± 1.76)	0.68 (± 0.36)	1.17 (± 0.1)	0.76 (± 0.06)	0.54 (± 0.65)	0.67 (± 0.82)
Low Compliance - IM	0.92 (± 0.17)	2.98 (± 1.45)	0.74 (± 1.2)	0.47 (± 0.11)	1.18 (± 0.12)	0.68 (± 0.15)	0.4 (± 0.54)	0.3 (± 0.34)
Flexible fisher behaviour - IM	0.92 (± 0.16)	3.47 (± 1.06)	0.85 (± 0.58)	0.74 (± 0.24)	0.96 (± 0.08)	0.8 (± 0.14)	0.53 (± 0.56)	0.52 (± 0.11)
Increased fishing pressure drivers - IM	0.92 (± 0.16)	3.55 (± 1.41)	1.32 (± 1.99)	0.62 (± 0.28)	1.16 (± 0.1)	0.73 (± 0.12)	0.44 (± 0.48)	0.48 (± 0.57)
High Cost, Low Values - IM	0.94 (± 0.19)	1.41 (± 1.41)	5.99 (± 5.3)	0.91 (± 0.21)	0.99 (± 0.12)	0.99 (± 0.2)	0.18 (± 0.2)	0.56 (± 0.42)
Low Costs, High Values - IM	0.72 (± 0.51)	2.67 (± 1.85)	2.08 (± 2.74)	0.68 (± 0.31)	0.9 (± 0.55)	0.56 (± 0.29)	0.67 (± 0.68)	0.32 (± 0.45)
Standard Markets - IM	0.92 (± 0.16)	3.55 (± 1.41)	0.15 (± 0.03)	0.62 (± 0.28)	1.16 (± 0.1)	0.73 (± 0.12)	0.44 (± 0.48)	0.54 (± 0.64)
Technology Creep - IM	0.93 (± 0.18)	2.38 (± 0.84)	4.95 (± 4.22)	0.87 (± 0.24)	1.02 (± 0.09)	0.9 (± 0.16)	0.69 (± 0.78)	0.57 (± 0.42)
No Acclimation - 2010 coastal context - IM	0.44 (± 0.31)	2.1 (± 1.85)	0.07 (± 0.04)	0.32 (± 0.27)	0.53 (± 0.36)	0.37 (± 0.25)	0.41 (± 0.53)	0.14 (± 0.16)
No Acclimation - Cumulative impacts - SQ	0.7 (± 0.68)	11.09 (± 11.01)	0.01 (± 0.02)	3.44 (± 5.78)	0.38 (± 0.23)	0.27 (± 0.24)	0.8 (± 1.19)	0.08 (± 0.12)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	2.83 (± 0.96)	3.07 (± 1.63)	2.44 (± 2.08)	2.86 (± 2.78)	2.7 (± 3.16)	0.81 (± 0.65)	3.57 (± 2.2)	1.3 (± 0.21)
2010 coastal context - Cap ecosystem take	2.13 (± 2.07)	0.91 (± 0.65)	1.46 (± 0.59)	2.42 (± 1.82)	1.34 (± 0.79)	0.28 (± 0.2)	12.44 (± 12.19)	1.1 (± 0.16)
2010 coastal context - Centralised mgmt.	2.64 (± 3.14)	0.96 (± 0.61)	1.69 (± 0.42)	2.34 (± 1.29)	1.64 (± 0.95)	0.39 (± 0.27)	10.97 (± 10.7)	1.12 (± 0.18)
2010 coastal context - FewMPA	5 (± 3.44)	0.88 (± 0.55)	0.93 (± 0.92)	1.82 (± 0.88)	1.5 (± 0.81)	0.26 (± 0.14)	2.27 (± 0.98)	0.8 (± 0.11)
2010 coastal context - Fragmented mgmt	1.99 (± 1.82)	0.93 (± 0.58)	1.13 (± 0.52)	1.74 (± 0.8)	1.62 (± 0.95)	0.36 (± 0.28)	18.54 (± 23.58)	1.07 (± 0.16)
2010 coastal context - ManyMPA	0.91 (± 0.2)	0.94 (± 0.61)	1.39 (± 0.72)	0.97 (± 0.54)	1.51 (± 0.83)	0.14 (± 0.17)	3.77 (± 5.58)	0.86 (± 0.05)
2010 coastal context - Seasons	1.57 (± 1.19)	1.03 (± 0.63)	0.96 (± 0.31)	1.9 (± 0.52)	1.78 (± 1.09)	0.09 (± 0.06)	0.73 (± 0.15)	0.86 (± 0.11)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
2010 coastal context - SlowAssess	1.03 (± 0.71)	0.98 (± 0.62)	1.24 (± 0.55)	2.72 (± 1.69)	1.7 (± 0.99)	0.49 (± 0.31)	6.09 (± 2.24)	1.12 (± 0.11)
2010 coastal context - Integrated Mgmt (IM)	1.59 (± 1.38)	2.26 (± 1.82)	1.64 (± 0.35)	0.98 (± 0.35)	2.32 (± 2.59)	0.23 (± 0.13)	2.14 (± 1.08)	1.09 (± 0.16)
Cumulative impacts - 2010 Status Quo (SQ)	3.47 (± 3.72)	0.92 (± 0.57)	1.23 (± 1.21)	2.28 (± 1.45)	1.66 (± 0.96)	0.55 (± 0.37)	6.25 (± 9.22)	0.94 (± 0.13)
Cumulative impacts - Cap ecosystem take	2.48 (± 2.72)	0.9 (± 0.64)	1.16 (± 1.27)	2.09 (± 1.31)	1.38 (± 0.83)	0.7 (± 0.76)	5.74 (± 8.73)	0.92 (± 0.16)
Cumulative impacts - Centralised mgmt.	3.14 (± 4.05)	0.95 (± 0.59)	1.36 (± 1.37)	2.04 (± 0.85)	1.67 (± 0.97)	0.89 (± 0.86)	5.08 (± 7.74)	0.94 (± 0.17)
Cumulative impacts - FewMPA	5.85 (± 4.53)	0.87 (± 0.54)	1.02 (± 1.52)	1.59 (± 0.56)	1.54 (± 0.83)	0.67 (± 0.61)	2.52 (± 4.19)	0.67 (± 0.11)
Cumulative impacts - Fragmented mgmt	2.3 (± 2.4)	0.92 (± 0.57)	1.35 (± 1.43)	1.52 (± 0.5)	1.66 (± 0.96)	0.82 (± 0.85)	9.63 (± 15.6)	0.9 (± 0.16)
Cumulative impacts - ManyMPA	0.96 (± 0.03)	0.93 (± 0.6)	1.26 (± 0.89)	0.84 (± 0.39)	1.54 (± 0.85)	0.21 (± 0.17)	0.66 (± 0.66)	0.72 (± 0.06)
Cumulative impacts - Seasons	1.78 (± 1.59)	1.02 (± 0.62)	1.04 (± 0.9)	1.69 (± 0.25)	1.82 (± 1.11)	0.25 (± 0.26)	0.19 (± 0.28)	0.72 (± 0.11)
Cumulative impacts - SlowAssess	1.19 (± 0.98)	0.97 (± 0.6)	1.14 (± 1.24)	2.36 (± 1.15)	1.73 (± 1.01)	1.22 (± 1.18)	1.59 (± 1.37)	0.93 (± 0.12)
Cumulative impacts - IM	1.84 (± 1.6)	2.23 (± 1.78)	1.14 (± 1.11)	0.91 (± 0.41)	2.35 (± 2.59)	0.5 (± 0.32)	0.88 (± 0.91)	0.91 (± 0.11)
Expanded LTL fishery - IM	1.19 (± 1.03)	0.96 (± 0.61)	1.49 (± 0.85)	1.92 (± 1.02)	1.69 (± 0.98)	0.43 (± 0.29)	8.13 (± 7.53)	1.12 (± 0.18)
New mesopelgic fishery - IM	1.02 (± 1.18)	0.94 (± 0.59)	1.66 (± 1.15)	1.83 (± 1.12)	1.69 (± 0.99)	0.41 (± 0.32)	9.96 (± 10.69)	1.08 (± 0.15)
Extreme climate events - IM	2.26 (± 1.65)	0.93 (± 0.58)	1.88 (± 0.84)	1.24 (± 0.25)	1.63 (± 0.95)	0.36 (± 0.27)	16.22 (± 15.42)	1.12 (± 0.15)
Blooms - IM	2.4 (± 2.23)	0.93 (± 0.59)	2.11 (± 1.31)	1.22 (± 0.39)	1.63 (± 0.95)	0.31 (± 0.26)	18.52 (± 19.78)	1.12 (± 0.11)
Primary production regime shift - IM	2.18 (± 1.51)	0.95 (± 0.61)	2.01 (± 1.49)	2.49 (± 1.85)	1.63 (± 0.95)	0.46 (± 0.39)	13.97 (± 19.29)	1.1 (± 0.12)
Fish kills - IM	3.07 (± 2.92)	0.93 (± 0.59)	1.81 (± 0.5)	2.68 (± 2.08)	1.63 (± 0.95)	0.3 (± 0.24)	15.15 (± 14.37)	1.12 (± 0.12)
Range extensions - IM	3.3 (± 2.04)	0.91 (± 0.57)	1.93 (± 0.82)	2.83 (± 1.48)	2.06 (± 0.23)	0.31 (± 0.24)	28.22 (± 37.93)	1.36 (± 0.48)
Gear switching allowed - IM	1.21 (± 1.25)	1.05 (± 0.66)	1.19 (± 0.82)	2.33 (± 0.99)	1.77 (± 1.06)	0.52 (± 0.38)	2.06 (± 1.3)	0.98 (± 0.13)
High compliance - IM	1.91 (± 1.19)	0.94 (± 0.59)	1.92 (± 1.2)	2.02 (± 0.97)	1.64 (± 0.96)	0.38 (± 0.26)	12.23 (± 12.44)	1.1 (± 0.13)
Low Compliance - IM	1.07 (± 1.02)	0.91 (± 0.57)	1.63 (± 1.12)	1.13 (± 0.25)	1.66 (± 0.97)	0.22 (± 0.17)	22.67 (± 27.01)	1.11 (± 0.12)
Flexible fisher behaviour - IM	2.52 (± 2.33)	0.96 (± 0.61)	1.39 (± 0.07)	2.67 (± 1.92)	1.64 (± 0.96)	0.32 (± 0.22)	9.26 (± 8.53)	1.11 (± 0.14)
Increased fishing pressure drivers - IM	3.03 (± 2.84)	0.93 (± 0.59)	1.44 (± 0.51)	2.67 (± 2.02)	1.63 (± 0.95)	0.28 (± 0.24)	14.21 (± 12.35)	1.12 (± 0.12)
High Cost, Low Values - IM	0.54 (± 0.23)	0.99 (± 0.65)	0.65 (± 0.94)	1.5 (± 1)	1.75 (± 1.01)	0.08 (± 0.05)	0.24 (± 0.36)	0.84 (± 0.08)
Low Costs, High Values - IM	1.24 (± 1.39)	0.9 (± 0.72)	0.95 (± 0.63)	2.17 (± 1.85)	1.06 (± 0.92)	0.27 (± 0.34)	10.66 (± 12.06)	1.08 (± 0.19)
Standard Markets - IM	3.03 (± 2.84)	0.93 (± 0.59)	1.73 (± 0.54)	2.67 (± 2.02)	1.63 (± 0.95)	0.28 (± 0.24)	14.21 (± 12.35)	1.12 (± 0.12)
Technology Creep - IM	1.39 (± 0.77)	0.98 (± 0.61)	1.14 (± 0.54)	0.8 (± 0.16)	1.49 (± 0.87)	0.44 (± 0.32)	3.12 (± 4.1)	1.03 (± 0.12)
No Acclimation - 2010 coastal context - IM	2.35 (± 3.5)	0.66 (± 0.66)	1.35 (± 1.03)	2.09 (± 2.67)	0.94 (± 1.09)	0.13 (± 0.13)	6.05 (± 7.73)	0.44 (± 0.63)
No Acclimation - Cumulative impacts - SQ	9.84 (± 14.15)	0.26 (± 0.21)	2.1 (± 1.16)	9.72 (± 15.5)	1.29 (± 1.64)	0.16 (± 0.12)	30.29 (± 45.05)	0.43 (± 0.6)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
No Climate change - 2010 context - SQ	1.11 (± 1.45)	1.42 (± 0.31)	3.72 (± 2.48)	0.87 (± 0.37)	3.62 (± 3.39)	1.83 (± 0.8)	0.99 (± 0.43)	0.74 (± 0.26)
2010 coastal context - Cap ecosystem take	7.16 (± 3.47)	1.36 (± 0.75)	1.98 (± 0.16)	1.12 (± 1.09)	0.79 (± 0.54)	1.08 (± 0.58)	1.09 (± 0.18)	0.26 (± 0.16)
2010 coastal context - Centralised mgmt.	8.02 (± 4.24)	1.38 (± 0.74)	1.7 (± 0.29)	1.11 (± 0.98)	0.92 (± 0.65)	1.17 (± 0.4)	0.98 (± 0.37)	0.27 (± 0.16)
2010 coastal context - FewMPA	5.41 (± 1.97)	1.34 (± 0.71)	2.97 (± 0.84)	0.01 (± 0.01)	0.83 (± 0.66)	1.2 (± 0.42)	0.64 (± 0.25)	0.25 (± 0.15)
2010 coastal context - Fragmented mgmt	7.54 (± 4.54)	1.37 (± 0.74)	2.31 (± 0.62)	1.06 (± 1.02)	0.93 (± 0.66)	1.18 (± 0.41)	0.98 (± 0.37)	0.26 (± 0.15)
2010 coastal context - ManyMPA	2.92 (± 4.72)	1.4 (± 0.75)	2.14 (± 0.77)	1.09 (± 1)	0.8 (± 0.55)	0.66 (± 0.31)	0.99 (± 0.37)	0.22 (± 0.13)
2010 coastal context - Seasons	1.9 (± 0.89)	1.41 (± 0.76)	1.13 (± 0.07)	1.35 (± 1.4)	0.72 (± 0.49)	0.65 (± 0.28)	0.99 (± 0.37)	0.21 (± 0.13)
2010 coastal context - SlowAssess	8.05 (± 3.23)	1.39 (± 0.73)	1.75 (± 0.76)	2.04 (± 2.63)	0.77 (± 0.48)	1.13 (± 0.36)	1 (± 0.4)	0.28 (± 0.17)
2010 coastal context - Integrated Mgmt (IM)	1.34 (± 1.14)	1.38 (± 0.51)	1.89 (± 0.62)	0.67 (± 0.69)	2.99 (± 2.71)	1.43 (± 1.06)	1.09 (± 0.38)	0.68 (± 0.22)
Cumulative impacts - 2010 Status Quo (SQ)	5.97 (± 3.42)	1.38 (± 0.73)	1.68 (± 0.58)	0.55 (± 0.58)	0.72 (± 0.45)	1.28 (± 0.44)	0.67 (± 0.25)	0.24 (± 0.14)
Cumulative impacts - Cap ecosystem take	5.93 (± 3.11)	1.36 (± 0.75)	2.24 (± 0.48)	0.56 (± 0.57)	0.64 (± 0.36)	1.18 (± 0.62)	0.75 (± 0.13)	0.24 (± 0.14)
Cumulative impacts - Centralised mgmt.	6.64 (± 3.71)	1.38 (± 0.74)	2.24 (± 0.25)	0.55 (± 0.52)	0.75 (± 0.42)	1.28 (± 0.42)	0.68 (± 0.26)	0.24 (± 0.14)
Cumulative impacts - FewMPA	4.47 (± 1.91)	1.35 (± 0.71)	0.96 (± 0.39)	0.01 (± 0.01)	0.67 (± 0.44)	1.31 (± 0.44)	0.44 (± 0.18)	0.22 (± 0.13)
Cumulative impacts - Fragmented mgmt	6.25 (± 3.92)	1.38 (± 0.74)	1.8 (± 0.12)	0.53 (± 0.54)	0.76 (± 0.49)	1.29 (± 0.43)	0.67 (± 0.25)	0.24 (± 0.14)
Cumulative impacts - ManyMPA	2.31 (± 3.72)	1.41 (± 0.75)	2.35 (± 0.72)	0.54 (± 0.53)	0.65 (± 0.38)	0.72 (± 0.33)	0.68 (± 0.26)	0.2 (± 0.12)
Cumulative impacts - Seasons	1.58 (± 0.82)	1.41 (± 0.75)	2.29 (± 1.48)	0.67 (± 0.73)	0.59 (± 0.32)	0.71 (± 0.3)	0.68 (± 0.26)	0.19 (± 0.11)
Cumulative impacts - SlowAssess	6.65 (± 2.96)	1.39 (± 0.73)	2.05 (± 0.61)	1.03 (± 1.37)	0.66 (± 0.45)	1.23 (± 0.38)	0.69 (± 0.28)	0.25 (± 0.16)
Cumulative impacts - IM	1.14 (± 1.03)	1.38 (± 0.5)	2.84 (± 1.26)	0.3 (± 0.29)	2.76 (± 2.98)	1.55 (± 1.15)	0.64 (± 0.29)	0.62 (± 0.19)
Expanded LTL fishery - IM	7.91 (± 4.2)	1.39 (± 0.75)	1.68 (± 0.32)	1.26 (± 1.2)	0.7 (± 0.57)	1.2 (± 0.41)	1 (± 0.38)	0.27 (± 0.16)
New mesopelgic fishery - IM	7.61 (± 4.7)	1.39 (± 0.75)	1.58 (± 0.79)	1.25 (± 1.19)	0.71 (± 0.59)	1.22 (± 0.42)	1 (± 0.38)	0.26 (± 0.16)
Extreme climate events - IM	7.6 (± 4.44)	1.37 (± 0.73)	2.2 (± 0.29)	1.19 (± 1.21)	0.76 (± 0.48)	1.19 (± 0.43)	0.97 (± 0.37)	0.26 (± 0.15)
Blooms - IM	7.24 (± 4.49)	1.37 (± 0.73)	2.41 (± 0.22)	1.09 (± 1.03)	0.7 (± 0.45)	1.19 (± 0.42)	0.97 (± 0.37)	0.26 (± 0.15)
Primary production regime shift - IM	8.63 (± 5.45)	1.39 (± 0.77)	2.29 (± 0.29)	1.43 (± 1.02)	0.66 (± 0.44)	1.17 (± 0.4)	1 (± 0.4)	0.27 (± 0.16)
Fish kills - IM	7.49 (± 4.34)	1.37 (± 0.74)	1.95 (± 0.42)	1.03 (± 0.93)	0.88 (± 0.64)	1.17 (± 0.41)	0.98 (± 0.37)	0.26 (± 0.15)
Range extensions - IM	8.4 (± 1.54)	1.61 (± 0.72)	2.8 (± 1.93)	1.63 (± 1.92)	1.02 (± 0.9)	1.08 (± 0.36)	0.93 (± 0.34)	0.34 (± 0.28)
Gear switching allowed - IM	8.42 (± 3.98)	1.41 (± 0.76)	1.36 (± 1.08)	1.15 (± 1.12)	0.72 (± 0.51)	0.68 (± 0.28)	0.99 (± 0.37)	0.26 (± 0.16)
High compliance - IM	8.02 (± 4.12)	1.38 (± 0.74)	2.36 (± 0.42)	1.23 (± 1.19)	1 (± 0.91)	1.18 (± 0.41)	0.98 (± 0.38)	0.26 (± 0.16)
Low Compliance - IM	5.67 (± 3.08)	1.37 (± 0.73)	2.4 (± 0.16)	0.96 (± 0.83)	0.73 (± 0.55)	1.23 (± 0.4)	0.97 (± 0.36)	0.26 (± 0.15)
Flexible fisher behaviour - IM	7.77 (± 4.13)	1.38 (± 0.74)	1.3 (± 0.44)	1.11 (± 1.02)	0.82 (± 0.55)	0.99 (± 0.35)	0.97 (± 0.37)	0.26 (± 0.16)
Increased fishing pressure drivers - IM	7.26 (± 4.16)	1.37 (± 0.73)	2.2 (± 0.34)	1.11 (± 1.1)	0.89 (± 0.67)	1.17 (± 0.41)	0.97 (± 0.37)	0.26 (± 0.16)
High Cost, Low Values - IM	0.68 (± 0.06)	1.41 (± 0.76)	0.74 (± 0.24)	0.96 (± 0.88)	0.67 (± 0.4)	0.67 (± 0.28)	1 (± 0.37)	0.21 (± 0.13)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
Low Costs, High Values - IM	7.05 (± 3.69)	1.34 (± 0.78)	1.2 (± 0.53)	1.14 (± 1.08)	0.68 (± 0.41)	0.99 (± 0.74)	1.2 (± 0.01)	0.26 (± 0.17)
Standard Markets - IM	7.26 (± 4.16)	1.37 (± 0.73)	2.38 (± 0.7)	1.11 (± 1.1)	0.89 (± 0.67)	1.17 (± 0.41)	0.97 (± 0.37)	0.26 (± 0.16)
Technology Creep - IM	7.84 (± 4.2)	1.4 (± 0.75)	1.58 (± 0.67)	1 (± 0.93)	1.01 (± 0.88)	0.97 (± 0.35)	1 (± 0.38)	0.27 (± 0.16)
No Acclimation - 2010 coastal context - IM	1.51 (± 1.4)	0.44 (± 0.56)	0.57 (± 0.5)	0.8 (± 1.32)	1.34 (± 1.31)	0.74 (± 0.67)	0.14 (± 0)	0.03 (± 0.02)
No Acclimation - Cumulative impacts - SQ	9.77 (± 9.26)	0.43 (± 0.55)	0.45 (± 0.38)	2.11 (± 3.6)	0.46 (± 0.54)	0.62 (± 0.31)	0.14 (± 0.03)	0.01 (± 0.01)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
No Climate change - 2010 context - SQ	1.47 (± 1.5)	1.44 (± 0.27)	1.53 (± 0.3)	1.66 (± 0.89)	1.52 (± 0.6)	0.65 (± 0.09)	1.13 (± 0.05)	0.14 (± 0.1)
2010 coastal context - Cap ecosystem take	6.27 (± 4.84)	1.66 (± 0.42)	1.21 (± 0.14)	1.2 (± 0.19)	0.25 (± 0.16)	0.43 (± 0.06)	0.99 (± 0.56)	0.11 (± 0.01)
2010 coastal context - Centralised mgmt.	5.88 (± 4.91)	1.39 (± 0.03)	1.06 (± 0.18)	1.03 (± 0.11)	0.21 (± 0.23)	0.36 (± 0.11)	1 (± 0.56)	0.1 (± 0.04)
2010 coastal context - FewMPA	5.55 (± 4.47)	1.43 (± 0.03)	0.5 (± 0.06)	0.94 (± 0.12)	0 (± 0)	0.27 (± 0.08)	0.65 (± 0.36)	0.1 (± 0.04)
2010 coastal context - Fragmented mgmt	5.51 (± 4.35)	1.4 (± 0.03)	1.03 (± 0.17)	1.02 (± 0.11)	0.2 (± 0.06)	0.36 (± 0.11)	0.98 (± 0.55)	0.1 (± 0.04)
2010 coastal context - ManyMPA	5.57 (± 4.57)	1.39 (± 0.03)	1.21 (± 0.17)	1.03 (± 0.1)	2.22 (± 1.4)	0.36 (± 0.12)	1.03 (± 0.57)	0.1 (± 0.04)
2010 coastal context - Seasons	5.29 (± 4.29)	1.4 (± 0.03)	1.22 (± 0.17)	1.03 (± 0.1)	2.23 (± 1.42)	0.37 (± 0.13)	1.02 (± 0.57)	0.1 (± 0.04)
2010 coastal context - SlowAssess	5.29 (± 4.07)	1.4 (± 0.04)	1.11 (± 0.28)	1.06 (± 0.14)	1.15 (± 1.19)	0.41 (± 0.2)	1.2 (± 0.92)	0.1 (± 0.04)
2010 coastal context - Integrated Mgmt (IM)	6.45 (± 4.95)	1.36 (± 0.08)	1.41 (± 0.41)	1.73 (± 0.86)	90.86 (± 155.29)	0.55 (± 0.2)	0.84 (± 0.48)	0.23 (± 0.16)
Cumulative impacts - 2010 Status Quo (SQ)	5.52 (± 4.47)	1.43 (± 0.03)	0.62 (± 0.08)	0.97 (± 0.1)	0.01 (± 0.01)	0.33 (± 0.1)	0.75 (± 0.43)	0.1 (± 0.04)
Cumulative impacts - Cap ecosystem take	6.08 (± 4.65)	1.69 (± 0.43)	0.75 (± 0.12)	1.14 (± 0.19)	86.3 (± 149.43)	0.4 (± 0.06)	0.9 (± 0.32)	0.11 (± 0.01)
Cumulative impacts - Centralised mgmt.	5.7 (± 4.73)	1.42 (± 0.03)	0.66 (± 0.09)	0.98 (± 0.1)	0.03 (± 0.05)	0.33 (± 0.1)	0.76 (± 0.42)	0.1 (± 0.04)
Cumulative impacts - FewMPA	5.38 (± 4.32)	1.45 (± 0.04)	0.31 (± 0.03)	0.9 (± 0.13)	0.01 (± 0.01)	0.25 (± 0.07)	0.5 (± 0.27)	0.1 (± 0.04)
Cumulative impacts - Fragmented mgmt	5.34 (± 4.18)	1.43 (± 0.03)	0.64 (± 0.09)	0.97 (± 0.1)	0.03 (± 0.05)	0.33 (± 0.1)	0.76 (± 0.41)	0.1 (± 0.04)
Cumulative impacts - ManyMPA	5.4 (± 4.42)	1.42 (± 0.03)	0.75 (± 0.08)	0.98 (± 0.09)	0.07 (± 0.09)	0.33 (± 0.11)	0.79 (± 0.43)	0.1 (± 0.04)
Cumulative impacts - Seasons	5.12 (± 4.13)	1.43 (± 0.03)	0.76 (± 0.08)	0.98 (± 0.09)	0.06 (± 0.08)	0.34 (± 0.11)	0.79 (± 0.43)	0.1 (± 0.04)
Cumulative impacts - SlowAssess	5.14 (± 3.91)	1.43 (± 0.04)	0.68 (± 0.15)	1.01 (± 0.14)	0.03 (± 0.05)	0.38 (± 0.18)	0.92 (± 0.7)	0.1 (± 0.04)
Cumulative impacts - IM	1.52 (± 1.55)	1.01 (± 0.53)	0.87 (± 0.22)	1.59 (± 0.94)	0.96 (± 1.48)	0.5 (± 0.18)	0.57 (± 0.38)	0.23 (± 0.16)
Expanded LTL fishery - IM	6.41 (± 5.29)	1.41 (± 0.03)	1.1 (± 0.19)	1.04 (± 0.11)	1.94 (± 2.64)	0.36 (± 0.11)	1.01 (± 0.57)	0.1 (± 0.04)
New mesopelgic fishery - IM	6.54 (± 5.45)	1.41 (± 0.03)	1.12 (± 0.2)	1.04 (± 0.11)	2.34 (± 2.43)	0.36 (± 0.11)	1.02 (± 0.59)	0.1 (± 0.04)
Extreme climate events - IM	4.8 (± 3.8)	1.4 (± 0.03)	1 (± 0.15)	1.02 (± 0.11)	0.89 (± 1.23)	0.36 (± 0.11)	0.98 (± 0.56)	0.1 (± 0.04)
Blooms - IM	5.12 (± 4.03)	1.4 (± 0.03)	1 (± 0.13)	1.02 (± 0.1)	1.12 (± 1.72)	0.36 (± 0.11)	0.98 (± 0.55)	0.1 (± 0.04)
Primary production regime shift - IM	4.66 (± 3.81)	1.41 (± 0.04)	1.09 (± 0.27)	1.06 (± 0.16)	0.81 (± 0.62)	1.13 (± 1.35)	1.09 (± 0.53)	0.1 (± 0.04)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
Fish kills - IM	5.26 (± 4.33)	1.4 (± 0.02)	1.01 (± 0.18)	1.02 (± 0.11)	0.46 (± 0.49)	0.36 (± 0.11)	0.98 (± 0.56)	0.1 (± 0.04)
Range extensions - IM	4.72 (± 3.74)	1.34 (± 0.09)	0.96 (± 0.11)	0.98 (± 0.1)	1.31 (± 1.83)	0.38 (± 0.14)	0.99 (± 0.57)	0.1 (± 0.04)
Gear switching allowed - IM	4.6 (± 3.68)	1.4 (± 0.02)	1.21 (± 0.17)	1.03 (± 0.1)	12.73 (± 19.38)	0.36 (± 0.12)	1.02 (± 0.57)	0.1 (± 0.04)
High compliance - IM	5.58 (± 4.35)	1.39 (± 0.03)	1.04 (± 0.24)	1.02 (± 0.11)	0.31 (± 0.15)	0.36 (± 0.11)	0.99 (± 0.57)	0.1 (± 0.04)
Low Compliance - IM	5.07 (± 4)	1.4 (± 0.03)	0.93 (± 0.12)	1.02 (± 0.11)	0.28 (± 0.46)	0.35 (± 0.11)	0.95 (± 0.51)	0.1 (± 0.04)
Flexible fisher behaviour - IM	4.07 (± 3.27)	1.39 (± 0.03)	1.06 (± 0.16)	1.01 (± 0.11)	1.93 (± 2.81)	0.36 (± 0.11)	1 (± 0.56)	0.1 (± 0.04)
Increased fishing pressure drivers - IM	5.69 (± 4.63)	1.4 (± 0.03)	1 (± 0.18)	1.02 (± 0.11)	0.47 (± 0.49)	0.36 (± 0.11)	0.98 (± 0.57)	0.1 (± 0.04)
High Cost, Low Values - IM	5.47 (± 4.3)	1.4 (± 0.03)	1.22 (± 0.17)	1.03 (± 0.1)	13.06 (± 19.91)	0.36 (± 0.12)	1.03 (± 0.57)	0.1 (± 0.04)
Low Costs, High Values - IM	6.85 (± 5.09)	1.91 (± 0.87)	1.41 (± 0.45)	1.37 (± 0.49)	1751.95 (± 3034)	0.39 (± 0.06)	1.37 (± 0.49)	0.13 (± 0.02)
Standard Markets - IM	5.69 (± 4.63)	1.4 (± 0.03)	1 (± 0.18)	1.02 (± 0.11)	0.47 (± 0.49)	0.36 (± 0.11)	0.98 (± 0.57)	0.1 (± 0.04)
Technology Creep - IM	5.7 (± 4.53)	1.39 (± 0.03)	1.18 (± 0.18)	1.04 (± 0.11)	7.74 (± 11.18)	0.36 (± 0.11)	1.02 (± 0.57)	0.1 (± 0.04)
No Acclimation - 2010 coastal context - IM	0.74 (± 0.58)	0.23 (± 0.11)	0.16 (± 0.05)	0.16 (± 0.06)	0.06 (± 0.09)	0.17 (± 0.07)	0.49 (± 0.33)	0.05 (± 0.02)
No Acclimation - Cumulative impacts - SQ	3.58 (± 4.15)	0.38 (± 0.18)	0.1 (± 0.06)	0.12 (± 0.06)	9.78 (± 16.95)	0.11 (± 0.04)	0.56 (± 0.23)	0.02 (± 0.02)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
No Climate change - 2010 context - SQ	1.15 (± 0.27)	1.08 (± 0.19)	1.5 (± 0.28)	1.31 (± 0.35)	0.96 (± 0.03)	0.98 (± 0.19)	1.46 (± 0.31)	3.47 (± 0.17)
2010 coastal context - Cap ecosystem take	0.08 (± 0.05)	0.76 (± 0.21)	0.72 (± 0.33)	0.37 (± 0.21)	0.88 (± 0.21)	1.1 (± 0.41)	1.13 (± 0.05)	3.62 (± 0.84)
2010 coastal context - Centralised mgmt.	0.06 (± 0.01)	0.63 (± 0)	0.69 (± 0.41)	0.35 (± 0.24)	0.73 (± 0.09)	1.02 (± 0.54)	1.22 (± 0.09)	4.13 (± 0.06)
2010 coastal context - FewMPA	0.06 (± 0.01)	0.63 (± 0)	0.52 (± 0.31)	0.19 (± 0.12)	0.08 (± 0.01)	1.05 (± 0.56)	1.12 (± 0.09)	4.13 (± 0.06)
2010 coastal context - Fragmented mgmt	0.06 (± 0.01)	0.63 (± 0)	0.68 (± 0.41)	0.35 (± 0.24)	0.71 (± 0.09)	1.02 (± 0.54)	1.22 (± 0.1)	4.13 (± 0.06)
2010 coastal context - ManyMPA	0.06 (± 0.01)	0.63 (± 0)	0.72 (± 0.43)	0.38 (± 0.26)	1.08 (± 0.17)	1.01 (± 0.54)	1.23 (± 0.1)	4.14 (± 0.06)
2010 coastal context - Seasons	0.06 (± 0.01)	0.63 (± 0)	0.71 (± 0.42)	0.38 (± 0.25)	1.03 (± 0.07)	1.01 (± 0.54)	1.23 (± 0.1)	4.13 (± 0.06)
2010 coastal context - SlowAssess	0.08 (± 0.03)	0.63 (± 0)	0.73 (± 0.46)	0.97 (± 1.19)	0.77 (± 0.18)	0.96 (± 0.5)	1.27 (± 0.1)	3.39 (± 1.26)
2010 coastal context - Integrated Mgmt (IM)	0.59 (± 0.64)	1.57 (± 0.3)	0.84 (± 0.54)	0.68 (± 0.55)	0.97 (± 0.05)	0.73 (± 0.51)	1.49 (± 0.36)	2.94 (± 0.09)
Cumulative impacts - 2010 Status Quo (SQ)	0.05 (± 0.01)	0.63 (± 0)	0.51 (± 0.31)	0.22 (± 0.15)	0.04 (± 0.01)	1.06 (± 0.57)	1.12 (± 0.09)	4.13 (± 0.06)
Cumulative impacts - Cap ecosystem take	0.07 (± 0.04)	0.76 (± 0.21)	0.55 (± 0.25)	0.24 (± 0.13)	0.05 (± 0.01)	1.14 (± 0.43)	1.04 (± 0.04)	3.62 (± 0.84)
Cumulative impacts - Centralised mgmt.	0.05 (± 0.01)	0.63 (± 0)	0.52 (± 0.31)	0.23 (± 0.15)	0.04 (± 0.01)	1.06 (± 0.56)	1.13 (± 0.09)	4.13 (± 0.06)
Cumulative impacts - FewMPA	0.05 (± 0.01)	0.64 (± 0)	0.39 (± 0.23)	0.12 (± 0.08)	0 (± 0)	1.09 (± 0.59)	1.04 (± 0.09)	4.13 (± 0.06)
Cumulative impacts - Fragmented mgmt	0.05 (± 0.01)	0.64 (± 0)	0.52 (± 0.31)	0.23 (± 0.15)	0.04 (± 0.01)	1.06 (± 0.57)	1.12 (± 0.09)	4.13 (± 0.06)
Cumulative impacts - ManyMPA	0.05 (± 0.01)	0.64 (± 0)	0.55 (± 0.32)	0.25 (± 0.17)	0.06 (± 0.01)	1.04 (± 0.56)	1.13 (± 0.1)	4.14 (± 0.06)
Cumulative impacts - Seasons	0.05 (± 0.01)	0.64 (± 0)	0.54 (± 0.32)	0.25 (± 0.16)	0.06 (± 0.01)	1.04 (± 0.56)	1.13 (± 0.1)	4.13 (± 0.06)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
Cumulative impacts - SlowAssess	0.07 (± 0.02)	0.64 (± 0)	0.56 (± 0.35)	0.62 (± 0.74)	0.05 (± 0.01)	1 (± 0.52)	1.18 (± 0.09)	4.06 (± 0.11)
Cumulative impacts - IM	0.51 (± 0.54)	1.57 (± 0.3)	0.64 (± 0.41)	0.45 (± 0.37)	0.06 (± 0.01)	0.76 (± 0.53)	1.37 (± 0.33)	2.61 (± 0.52)
Expanded LTL fishery - IM	0.06 (± 0.01)	0.64 (± 0)	0.7 (± 0.42)	0.36 (± 0.24)	0.77 (± 0.08)	1.02 (± 0.54)	1.22 (± 0.1)	4.14 (± 0.06)
New mesopelgic fishery - IM	0.06 (± 0.01)	0.64 (± 0)	0.7 (± 0.42)	0.37 (± 0.25)	0.81 (± 0.14)	1.01 (± 0.54)	1.22 (± 0.1)	4.14 (± 0.06)
Extreme climate events - IM	0.06 (± 0.01)	0.63 (± 0)	0.67 (± 0.4)	0.34 (± 0.23)	0.68 (± 0.1)	1.02 (± 0.55)	1.21 (± 0.1)	4.13 (± 0.06)
Blooms - IM	0.06 (± 0.01)	0.63 (± 0)	0.67 (± 0.4)	0.34 (± 0.23)	0.68 (± 0.07)	1.03 (± 0.55)	1.21 (± 0.1)	4.13 (± 0.06)
Primary production regime shift - IM	0.08 (± 0.03)	0.63 (± 0)	0.73 (± 0.46)	1.09 (± 1.43)	0.72 (± 0.14)	0.97 (± 0.5)	1.27 (± 0.09)	3.41 (± 1.3)
Fish kills - IM	0.06 (± 0.01)	0.63 (± 0)	0.67 (± 0.41)	0.34 (± 0.23)	0.68 (± 0.11)	1.02 (± 0.54)	1.21 (± 0.1)	4.13 (± 0.06)
Range extensions - IM	0.06 (± 0.01)	0.64 (± 0)	0.67 (± 0.4)	0.35 (± 0.23)	0.67 (± 0.03)	1.03 (± 0.55)	1.22 (± 0.1)	4.13 (± 0.06)
Gear switching allowed - IM	0.06 (± 0.01)	0.63 (± 0)	0.7 (± 0.42)	0.37 (± 0.25)	1.02 (± 0.05)	1.01 (± 0.54)	1.23 (± 0.1)	4.13 (± 0.06)
High compliance - IM	0.06 (± 0.01)	0.63 (± 0)	0.68 (± 0.42)	0.35 (± 0.24)	0.71 (± 0.15)	1.02 (± 0.54)	1.22 (± 0.09)	4.13 (± 0.06)
Low Compliance - IM	0.06 (± 0.01)	0.63 (± 0)	0.65 (± 0.39)	0.33 (± 0.22)	0.65 (± 0.03)	1.03 (± 0.55)	1.21 (± 0.1)	4.13 (± 0.06)
Flexible fisher behaviour - IM	0.06 (± 0.01)	0.63 (± 0)	0.69 (± 0.41)	0.35 (± 0.24)	0.74 (± 0.09)	1.02 (± 0.54)	1.22 (± 0.1)	4.13 (± 0.06)
Increased fishing pressure drivers - IM	0.06 (± 0.01)	0.63 (± 0)	0.67 (± 0.4)	0.34 (± 0.23)	0.68 (± 0.12)	1.02 (± 0.54)	1.21 (± 0.1)	4.13 (± 0.06)
High Cost, Low Values - IM	0.06 (± 0.01)	0.64 (± 0)	0.71 (± 0.42)	0.38 (± 0.25)	1.11 (± 0.02)	1.01 (± 0.54)	1.23 (± 0.1)	4.13 (± 0.06)
Low Costs, High Values - IM	0.11 (± 0.09)	0.88 (± 0.43)	0.77 (± 0.26)	0.39 (± 0.18)	1.08 (± 0.53)	1.17 (± 0.28)	1.05 (± 0.2)	4.21 (± 0.18)
Standard Markets - IM	0.06 (± 0.01)	0.63 (± 0)	0.67 (± 0.4)	0.34 (± 0.23)	0.68 (± 0.12)	1.02 (± 0.54)	1.21 (± 0.1)	4.13 (± 0.06)
Technology Creep - IM	0.06 (± 0.01)	0.63 (± 0)	0.69 (± 0.41)	0.37 (± 0.25)	0.85 (± 0.09)	1.01 (± 0.54)	1.23 (± 0.1)	4.13 (± 0.06)
No Acclimation - 2010 coastal context - IM	0.03 (± 0)	0.5 (± 0.11)	0.55 (± 0.38)	0.28 (± 0.21)	0.54 (± 0.2)	0.83 (± 0.53)	0.53 (± 0.04)	2 (± 0.2)
No Acclimation - Cumulative impacts - SQ	0.01 (± 0)	0.21 (± 0.06)	0.38 (± 0.21)	0.12 (± 0.08)	0.21 (± 0.16)	1.28 (± 0.7)	0.43 (± 0.06)	2.81 (± 0.23)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
No Climate change - 2010 context - SQ	2.43 (± 1.96)	1.52 (± 0.1)	0.93 (± 0.28)	0.88 (± 0.26)	0.98 (± 0.35)	1.7 (± 0.99)	1.14 (± 0.09)	4.14 (± 0.95)
2010 coastal context - Cap ecosystem take	3.24 (± 3.24)	1.15 (± 0.13)	1.48 (± 0.71)	2.76 (± 0.76)	0.84 (± 0.16)	1.18 (± 0.3)	1.08 (± 0.06)	1.54 (± 0.07)
2010 coastal context - Centralised mgmt.	4.56 (± 5.51)	1.22 (± 0)	1.07 (± 0.01)	3.11 (± 0.19)	0.95 (± 0.06)	1.19 (± 0.27)	1.1 (± 0.09)	1.82 (± 0.43)
2010 coastal context - FewMPA	4.57 (± 5.47)	1.09 (± 0)	1.11 (± 0.01)	3.18 (± 0.19)	0.96 (± 0.05)	1.2 (± 0.27)	1.11 (± 0.09)	1.84 (± 0.43)
2010 coastal context - Fragmented mgmt	4.56 (± 5.51)	1.22 (± 0.01)	1.07 (± 0.01)	3.12 (± 0.19)	0.96 (± 0.06)	1.19 (± 0.27)	1.1 (± 0.09)	1.82 (± 0.43)
2010 coastal context - ManyMPA	4.64 (± 5.63)	1.22 (± 0)	1.06 (± 0.01)	3.09 (± 0.19)	0.94 (± 0.05)	1.19 (± 0.27)	1.09 (± 0.09)	1.81 (± 0.42)
2010 coastal context - Seasons	4.6 (± 5.56)	1.22 (± 0)	1.06 (± 0.01)	3.09 (± 0.19)	0.94 (± 0.05)	1.19 (± 0.27)	1.09 (± 0.09)	1.81 (± 0.42)
2010 coastal context - SlowAssess	4.54 (± 5.51)	1.23 (± 0.01)	1.07 (± 0.02)	2.64 (± 0.65)	0.96 (± 0.06)	1.14 (± 0.24)	1.11 (± 0.09)	1.84 (± 0.41)
2010 coastal context - Integrated Mgmt (IM)	1.94 (± 1.78)	1.7 (± 0.52)	0.82 (± 0.43)	4.17 (± 5.5)	0.82 (± 0.2)	1.04 (± 0.2)	1.17 (± 0.11)	2.13 (± 1.15)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
Cumulative impacts - 2010 Status Quo (SQ)	4.61 (± 5.54)	1.09 (± 0)	1.16 (± 0.01)	3.17 (± 0.19)	1.03 (± 0.06)	1.21 (± 0.27)	1.16 (± 0.09)	1.88 (± 0.44)
Cumulative impacts - Cap ecosystem take	3.28 (± 3.26)	1.02 (± 0.12)	1.58 (± 0.75)	2.8 (± 0.78)	0.9 (± 0.18)	1.19 (± 0.3)	1.13 (± 0.05)	1.59 (± 0.07)
Cumulative impacts - Centralised mgmt.	4.61 (± 5.55)	1.09 (± 0)	1.15 (± 0.01)	3.16 (± 0.2)	1.02 (± 0.06)	1.2 (± 0.28)	1.15 (± 0.09)	1.88 (± 0.44)
Cumulative impacts - FewMPA	4.63 (± 5.5)	0.97 (± 0)	1.19 (± 0.01)	3.23 (± 0.2)	1.03 (± 0.06)	1.21 (± 0.28)	1.16 (± 0.09)	1.89 (± 0.44)
Cumulative impacts - Fragmented mgmt	4.61 (± 5.55)	1.09 (± 0)	1.15 (± 0.01)	3.17 (± 0.2)	1.04 (± 0.06)	1.2 (± 0.28)	1.15 (± 0.09)	1.88 (± 0.44)
Cumulative impacts - ManyMPA	4.69 (± 5.67)	1.08 (± 0)	1.14 (± 0.01)	3.14 (± 0.19)	1 (± 0.05)	1.2 (± 0.27)	1.14 (± 0.09)	1.87 (± 0.43)
Cumulative impacts - Seasons	4.66 (± 5.6)	1.08 (± 0)	1.14 (± 0.01)	3.14 (± 0.19)	1.01 (± 0.05)	1.2 (± 0.27)	1.14 (± 0.09)	1.87 (± 0.43)
Cumulative impacts - SlowAssess	4.63 (± 5.52)	1.09 (± 0.01)	1.15 (± 0.01)	2.68 (± 0.65)	1.03 (± 0.06)	1.15 (± 0.24)	1.16 (± 0.09)	1.9 (± 0.43)
Cumulative impacts - IM	2.16 (± 1.68)	1.51 (± 0.46)	0.88 (± 0.47)	4.23 (± 5.58)	0.88 (± 0.21)	1.05 (± 0.2)	1.23 (± 0.11)	3.25 (± 1.19)
Expanded LTL fishery - IM	4.6 (± 5.58)	1.23 (± 0.01)	1.07 (± 0.01)	3.12 (± 0.18)	0.95 (± 0.06)	1.19 (± 0.27)	1.1 (± 0.09)	1.82 (± 0.42)
New mesopelgic fishery - IM	4.6 (± 5.58)	1.23 (± 0.01)	1.07 (± 0.01)	3.12 (± 0.18)	0.95 (± 0.06)	1.19 (± 0.27)	1.09 (± 0.09)	1.82 (± 0.43)
Extreme climate events - IM	4.56 (± 5.51)	1.22 (± 0)	1.08 (± 0.01)	3.12 (± 0.19)	0.96 (± 0.05)	1.19 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.42)
Blooms - IM	4.56 (± 5.51)	1.22 (± 0)	1.08 (± 0.01)	3.12 (± 0.19)	0.96 (± 0.05)	1.2 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.42)
Primary production regime shift - IM	4.26 (± 5.74)	1.23 (± 0.01)	1.07 (± 0.02)	2.68 (± 0.83)	0.96 (± 0.06)	1.14 (± 0.24)	1.11 (± 0.08)	1.84 (± 0.41)
Fish kills - IM	4.55 (± 5.5)	1.22 (± 0)	1.08 (± 0.01)	3.12 (± 0.18)	0.96 (± 0.06)	1.2 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.43)
Range extensions - IM	4.56 (± 5.52)	1.23 (± 0.01)	1.07 (± 0.01)	3.12 (± 0.19)	0.96 (± 0.05)	1.2 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.42)
Gear switching allowed - IM	4.64 (± 5.62)	1.22 (± 0)	1.06 (± 0.01)	3.09 (± 0.19)	0.94 (± 0.05)	1.19 (± 0.27)	1.09 (± 0.09)	1.81 (± 0.42)
High compliance - IM	4.55 (± 5.5)	1.22 (± 0.01)	1.07 (± 0.02)	3.12 (± 0.18)	0.96 (± 0.07)	1.19 (± 0.27)	1.1 (± 0.1)	1.82 (± 0.43)
Low Compliance - IM	4.55 (± 5.5)	1.22 (± 0)	1.08 (± 0.01)	3.13 (± 0.2)	0.97 (± 0.06)	1.2 (± 0.27)	1.11 (± 0.09)	1.83 (± 0.42)
Flexible fisher behaviour - IM	4.56 (± 5.52)	1.22 (± 0)	1.07 (± 0.01)	3.12 (± 0.18)	0.96 (± 0.05)	1.19 (± 0.27)	1.1 (± 0.09)	1.82 (± 0.42)
Increased fishing pressure drivers - IM	4.55 (± 5.5)	1.22 (± 0)	1.08 (± 0.01)	3.12 (± 0.18)	0.96 (± 0.06)	1.19 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.43)
High Cost, Low Values - IM	4.6 (± 5.55)	1.22 (± 0)	1.06 (± 0.01)	3.09 (± 0.19)	0.94 (± 0.05)	1.19 (± 0.27)	1.09 (± 0.09)	1.81 (± 0.42)
Low Costs, High Values - IM	3.91 (± 4.4)	1.07 (± 0.27)	1.88 (± 1.4)	2.4 (± 1.38)	0.71 (± 0.38)	1.16 (± 0.32)	1.06 (± 0.02)	1.26 (± 0.56)
Standard Markets - IM	4.55 (± 5.5)	1.22 (± 0)	1.08 (± 0.01)	3.12 (± 0.18)	0.96 (± 0.06)	1.19 (± 0.27)	1.1 (± 0.09)	1.83 (± 0.43)
Technology Creep - IM	4.59 (± 5.54)	1.22 (± 0)	1.06 (± 0.01)	3.1 (± 0.19)	0.94 (± 0.05)	1.19 (± 0.27)	1.09 (± 0.09)	1.82 (± 0.42)
No Acclimation - 2010 coastal context - IM	6.35 (± 7.52)	0.7 (± 0.28)	1.23 (± 0.38)	1.08 (± 0.92)	0.92 (± 0.79)	1.07 (± 0.6)	1.25 (± 0.28)	6.16 (± 6.27)
No Acclimation - Cumulative impacts - SQ	15.38 (± 22.34)	0.58 (± 0.47)	2.61 (± 2.68)	3.88 (± 4.1)	1.03 (± 0.68)	1.25 (± 0.72)	1.19 (± 0.25)	2.9 (± 2.52)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	2.18 (± 0.7)	0.7 (± 0.23)	106.33 (± 86.88)	29.89 (± 13.06)
2010 coastal context - Cap ecosystem take	4.12 (± 0.22)	2.11 (± 0.25)	122.72 (± 209.12)	12.25 (± 18.67)
2010 coastal context - Centralised mgmt.	4.84 (± 1.07)	2.25 (± 0.02)	192.36 (± 329.75)	18.71 (± 29.84)
2010 coastal context - FewMPA	5.01 (± 1.09)	2.31 (± 0.02)	197.56 (± 338.65)	18.89 (± 30.12)
2010 coastal context - Fragmented mgmt	4.86 (± 1.07)	2.26 (± 0.03)	192.71 (± 330.32)	18.75 (± 29.9)
2010 coastal context - ManyMPA	4.75 (± 1.03)	2.22 (± 0.02)	187.75 (± 321.82)	18.32 (± 29.21)
2010 coastal context - Seasons	4.75 (± 1.02)	2.22 (± 0.02)	187.77 (± 321.85)	18.31 (± 29.2)
2010 coastal context - SlowAssess	4.99 (± 1.01)	2.41 (± 0.28)	194.28 (± 332.82)	19 (± 29.98)
2010 coastal context - Integrated Mgmt (IM)	4.38 (± 0.42)	0.83 (± 0.36)	154.63 (± 213.64)	28.06 (± 30.52)
Cumulative impacts - 2010 Status Quo (SQ)	5.06 (± 1.11)	2.47 (± 0.03)	200.6 (± 343.87)	19.7 (± 31.41)
Cumulative impacts - Cap ecosystem take	4.27 (± 0.24)	2.3 (± 0.28)	127.08 (± 216.52)	12.82 (± 19.52)
Cumulative impacts - Centralised mgmt.	5.02 (± 1.1)	2.46 (± 0.03)	199.19 (± 341.43)	19.58 (± 31.21)
Cumulative impacts - FewMPA	5.19 (± 1.12)	2.53 (± 0.03)	204.57 (± 350.64)	19.77 (± 31.49)
Cumulative impacts - Fragmented mgmt	5.04 (± 1.1)	2.46 (± 0.04)	199.55 (± 342.02)	19.62 (± 31.26)
Cumulative impacts - ManyMPA	4.92 (± 1.05)	2.42 (± 0.03)	194.42 (± 333.21)	19.17 (± 30.54)
Cumulative impacts - Seasons	4.93 (± 1.05)	2.42 (± 0.03)	194.44 (± 333.25)	19.17 (± 30.53)
Cumulative impacts - SlowAssess	5.17 (± 1.05)	2.63 (± 0.31)	201.18 (± 344.6)	19.89 (± 31.34)
Cumulative impacts - IM	3.46 (± 2.15)	0.91 (± 0.39)	160.29 (± 221.1)	29.44 (± 31.89)
Expanded LTL fishery - IM	4.98 (± 1.09)	2.25 (± 0.02)	196.27 (± 336.44)	18.87 (± 30.1)
New mesopelgic fishery - IM	4.96 (± 1.1)	2.24 (± 0.02)	196.26 (± 336.45)	18.87 (± 30.11)
Extreme climate events - IM	4.88 (± 1.06)	2.26 (± 0.01)	192.87 (± 330.62)	18.75 (± 29.9)
Blooms - IM	4.88 (± 1.04)	2.26 (± 0.02)	192.13 (± 329.31)	18.7 (± 29.81)
Primary production regime shift - IM	4.99 (± 0.98)	2.41 (± 0.24)	193.3 (± 331.36)	18.8 (± 29.98)
Fish kills - IM	4.88 (± 1.08)	2.26 (± 0.02)	193.73 (± 332.1)	18.83 (± 30.04)
Range extensions - IM	4.89 (± 1.03)	2.26 (± 0.03)	192.14 (± 329.29)	18.71 (± 29.8)
Gear switching allowed - IM	4.75 (± 1.02)	2.22 (± 0.02)	187.68 (± 321.69)	18.31 (± 29.19)
High compliance - IM	4.87 (± 1.12)	2.26 (± 0.03)	194.95 (± 334.23)	18.93 (± 30.24)
Low Compliance - IM	4.92 (± 1.05)	2.28 (± 0.03)	193.95 (± 332.42)	18.88 (± 30.08)
Flexible fisher behaviour - IM	4.83 (± 1.05)	2.25 (± 0.02)	191.11 (± 327.59)	18.61 (± 29.68)
Increased fishing pressure drivers - IM	4.88 (± 1.08)	2.26 (± 0.01)	193.73 (± 332.11)	18.83 (± 30.04)
High Cost, Low Values - IM	4.75 (± 1.02)	2.22 (± 0.02)	187.6 (± 321.55)	18.3 (± 29.18)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
Low Costs, High Values - IM	3.36 (± 1.52)	1.96 (± 0.5)	51.7 (± 86.13)	5.67 (± 7.35)
Standard Markets - IM	4.88 (± 1.08)	2.26 (± 0.01)	193.73 (± 332.11)	18.83 (± 30.04)
Technology Creep - IM	4.77 (± 1.03)	2.23 (± 0.02)	188.62 (± 323.32)	18.4 (± 29.34)
No Acclimation - 2010 coastal context - IM	14.07 (± 17.85)	0.99 (± 0.03)	19297.31 (± 33396.6)	386.67 (± 649.95)
No Acclimation - Cumulative impacts - SQ	60.65 (± 90.34)	3.15 (± 1.38)	27930.61 (± 48375.5)	331.81 (± 571.95)

Table A. 2: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SE for each strategy-scenario combination under RCP 4.5. Biomass is relative to 2010 model values.

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	1.53 (± 0.47)	17.82 (± 23.26)	1.34 (± 1.46)	1.25 (± 0.82)	2.19 (± 1.39)	1.3 (± 0.42)	1.96 (± 1.75)
2010 coastal context - Cap ecosystem take	4.04 (± 4.69)	8.08 (± 4.52)	11.75 (± 17.64)	0.04 (± 0.03)	0.45 (± 0.66)	1.45 (± 1.58)	16.28 (± 22.37)
2010 coastal context - Centralised mgmt.	4.29 (± 4.51)	11.18 (± 10.25)	11.6 (± 17.58)	0.06 (± 0.05)	0.66 (± 0.94)	2.08 (± 1.54)	18.17 (± 22.68)
2010 coastal context - FewMPA	4.01 (± 4.1)	7.56 (± 3.89)	8.91 (± 13.2)	0 (± 0)	0 (± 0)	0.5 (± 0.5)	9.04 (± 10.66)
2010 coastal context - Fragmented mgmt	4.3 (± 4.5)	11.01 (± 9.28)	11.53 (± 17.39)	0.05 (± 0.07)	0.68 (± 1.07)	0.87 (± 0.82)	17.96 (± 23.25)
2010 coastal context - ManyMPA	4.27 (± 4.47)	4.47 (± 3.11)	6.45 (± 9.73)	1.9 (± 0.69)	5.34 (± 6.07)	2.55 (± 2.34)	4.27 (± 4.94)
2010 coastal context - Seasons	4.29 (± 4.51)	4.46 (± 3.47)	6.6 (± 9.99)	1.74 (± 0.6)	5.35 (± 5.8)	2.47 (± 2.22)	6.51 (± 8.53)
2010 coastal context - SlowAssess	4.29 (± 4.46)	12.03 (± 11.91)	11.77 (± 18.02)	0.35 (± 0.53)	1 (± 0.83)	1.18 (± 1.52)	18.58 (± 23.82)
2010 coastal context - Integrated Mgmt (IM)	3.97 (± 5.43)	11.6 (± 5.54)	4.43 (± 6.75)	5.28 (± 6.92)	5.63 (± 7.46)	5.76 (± 8.22)	5.85 (± 9)
Cumulative impacts - 2010 Status Quo (SQ)	4.21 (± 4.36)	15.64 (± 11.01)	9.85 (± 14.54)	0 (± 0)	0 (± 0)	0.19 (± 0.21)	11.5 (± 13.61)
Cumulative impacts - Cap ecosystem take	3.99 (± 4.59)	12.33 (± 4.61)	9.89 (± 14.42)	0 (± 0)	0 (± 0)	0.15 (± 0.19)	11.88 (± 15.43)
Cumulative impacts - Centralised mgmt.	4.24 (± 4.41)	16.63 (± 12.93)	9.75 (± 14.38)	0 (± 0)	0 (± 0)	0.19 (± 0.2)	13.39 (± 15.5)
Cumulative impacts - FewMPA	3.96 (± 4.02)	12.65 (± 5.97)	7.52 (± 10.77)	0 (± 0)	0 (± 0)	0.05 (± 0.06)	6.71 (± 7.23)
Cumulative impacts - Fragmented mgmt	4.24 (± 4.41)	16.47 (± 11.47)	9.7 (± 14.22)	0 (± 0)	0 (± 0)	0.08 (± 0.1)	13.18 (± 15.97)
Cumulative impacts - ManyMPA	4.22 (± 4.38)	6.59 (± 3.57)	5.42 (± 7.96)	0 (± 0)	0 (± 0)	0.25 (± 0.29)	3.18 (± 3.33)
Cumulative impacts - Seasons	4.23 (± 4.41)	6.76 (± 4.2)	5.55 (± 8.17)	0 (± 0)	0 (± 0)	0.24 (± 0.27)	4.77 (± 5.86)
Cumulative impacts - SlowAssess	4.24 (± 4.37)	17.16 (± 15.53)	9.88 (± 14.75)	0 (± 0)	0 (± 0)	0.12 (± 0.18)	13.64 (± 16.34)
Cumulative impacts - IM	3.91 (± 5.32)	18.01 (± 5.21)	3.72 (± 5.53)	0 (± 0)	0 (± 0)	0.62 (± 0.94)	4.21 (± 6.27)
Expanded LTL fishery - IM	4.3 (± 4.49)	11.6 (± 10.27)	11.3 (± 17.11)	0.15 (± 0.12)	1.16 (± 1.6)	1.07 (± 0.89)	18.9 (± 24.08)
New mesopelgic fishery - IM	4.3 (± 4.49)	11.82 (± 10.02)	11.31 (± 17.09)	0.3 (± 0.27)	1.17 (± 1.59)	0.11 (± 0.1)	19.2 (± 23.79)

Extreme climate events - IM	4.29 (± 4.49)	10.63 (± 8.42)	11.91 (± 18.09)	0.02 (± 0.02)	0.19 (± 0.19)	1.36 (± 1.88)	16.41 (± 20.69)
Blooms - IM	4.27 (± 4.48)	11.12 (± 9.56)	11.83 (± 17.92)	0.01 (± 0)	0.23 (± 0.28)	2.25 (± 2.29)	16.5 (± 20.51)
Primary production regime shift - IM	4.37 (± 4.65)	10.45 (± 8.79)	11.4 (± 17.19)	0.38 (± 0.64)	1.99 (± 3.34)	1.27 (± 1.48)	20.32 (± 27.6)
Fish kills - IM	4.28 (± 4.49)	10.44 (± 8.91)	11.81 (± 17.92)	0.02 (± 0.01)	0.32 (± 0.46)	0.54 (± 0.17)	16.32 (± 21.09)
Range extensions - IM	4.28 (± 4.5)	10.69 (± 10.08)	11.88 (± 18.05)	0.02 (± 0.01)	0.33 (± 0.34)	1.14 (± 1.01)	17.15 (± 21.15)
Gear switching allowed - IM	4.24 (± 4.44)	5.45 (± 4.84)	6.63 (± 10.07)	1.8 (± 0.7)	4.01 (± 3.99)	2.38 (± 2.08)	7.59 (± 9.84)
High compliance - IM	4.29 (± 4.5)	11.31 (± 9.47)	11.48 (± 17.4)	0.09 (± 0.09)	0.8 (± 1.27)	1.98 (± 1.73)	18.17 (± 24.64)
Low Compliance - IM	4.33 (± 4.55)	16.53 (± 16.59)	12.16 (± 18.41)	0 (± 0)	0.17 (± 0.24)	1.8 (± 1.49)	20.51 (± 26.14)
Flexible fisher behaviour - IM	4.12 (± 4.32)	10.52 (± 8.87)	10.58 (± 16.05)	0.09 (± 0.04)	0.76 (± 0.98)	1.11 (± 1.84)	18 (± 22.32)
Increased fishing pressure drivers - IM	4.26 (± 4.46)	10.48 (± 8.89)	11.72 (± 17.77)	0.02 (± 0.02)	0.22 (± 0.28)	1.67 (± 1.31)	15.64 (± 19.86)
High Cost, Low Values - IM	4.27 (± 4.48)	5.35 (± 4.54)	6.47 (± 9.78)	1.77 (± 0.6)	5.57 (± 6.03)	2.55 (± 2.3)	4.58 (± 5.36)
Low Costs, High Values - IM	3.82 (± 4.94)	5.69 (± 2.23)	11.79 (± 17.5)	0.06 (± 0.05)	0.67 (± 1.04)	0.34 (± 0.33)	16.92 (± 24.98)
Standard Markets - IM	4.26 (± 4.46)	10.48 (± 8.89)	11.72 (± 17.77)	0.02 (± 0.02)	0.22 (± 0.28)	1.88 (± 1.73)	15.64 (± 19.86)
Technology Creep - IM	4.22 (± 4.44)	10.15 (± 9.26)	9.99 (± 15.33)	0.98 (± 0.33)	2.83 (± 2.71)	0.44 (± 0.55)	18.71 (± 23.96)
No Acclimation - 2010 coastal context - IM	2.24 (± 2.85)	4.16 (± 2.89)	6.64 (± 10.56)	0.01 (± 0.01)	0.2 (± 0.32)	1.46 (± 2.19)	14.13 (± 22.34)
No Acclimation - Cumulative impacts - SQ	2.41 (± 2.36)	3.8 (± 0.97)	17.58 (± 27.77)	0 (± 0)	0 (± 0)	0.44 (± 0.51)	40.19 (± 48.17)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	1.06 (± 0.59)	2.65 (± 2.04)	1.58 (± 1.02)	4.81 (± 6.1)	1.68 (± 0.26)	2.04 (± 2.54)	1.03 (± 0.5)	2.1 (± 2.52)
2010 coastal context - Cap ecosystem take	15.1 (± 24.97)	5.45 (± 1.39)	0.67 (± 0.45)	94.99 (± 152.3)	4.61 (± 6.33)	7.13 (± 11.23)	20.1 (± 34.29)	6.46 (± 11.12)
2010 coastal context - Centralised mgmt.	15.35 (± 25.16)	6.56 (± 3.08)	0.76 (± 0.93)	119.87 (± 194.12)	4.77 (± 6.19)	7.6 (± 11.69)	23.65 (± 40.45)	9.73 (± 16.59)
2010 coastal context - FewMPA	12.22 (± 19.75)	5.72 (± 1.32)	0.1 (± 0.13)	13.42 (± 21.33)	5.11 (± 6.59)	2.22 (± 3.42)	11.11 (± 18.63)	4.93 (± 8.46)
2010 coastal context - Fragmented mgmt	15.15 (± 24.82)	6.39 (± 3.74)	0.74 (± 1.13)	115.39 (± 186.06)	4.77 (± 6.19)	7.59 (± 11.77)	22.56 (± 38.78)	5.51 (± 9.32)
2010 coastal context - ManyMPA	15.93 (± 26.15)	3.35 (± 2.84)	5.22 (± 5.45)	167.04 (± 271.95)	3.97 (± 5.09)	9.22 (± 14.18)	0.54 (± 0.84)	20.68 (± 35.06)
2010 coastal context - Seasons	15.45 (± 25.32)	4.1 (± 3.56)	5.08 (± 5.1)	174.85 (± 286.68)	4.2 (± 5.49)	9.34 (± 14.33)	12.03 (± 20.63)	10.92 (± 18.17)
2010 coastal context - SlowAssess	15.31 (± 25.07)	5.9 (± 2.55)	0.88 (± 0.77)	95.72 (± 152.22)	4.78 (± 6.21)	7.63 (± 11.69)	25.78 (± 43.99)	7.78 (± 13.35)
2010 coastal context - Integrated Mgmt (IM)	6.3 (± 9.48)	1.46 (± 0.6)	9.43 (± 9.21)	7.52 (± 11.01)	7.93 (± 11.52)	8.02 (± 12.31)	7.95 (± 13.24)	8.48 (± 13.65)
Cumulative impacts - 2010 Status Quo (SQ)	12.76 (± 20.66)	6.99 (± 3.26)	0.38 (± 0.29)	0.01 (± 0.01)	5.15 (± 6.72)	2.46 (± 3.79)	26.21 (± 44.94)	5.26 (± 8.99)
Cumulative impacts - Cap ecosystem take	12.76 (± 20.92)	5.14 (± 1.56)	3.7 (± 5.35)	0.01 (± 0.01)	4.98 (± 6.86)	2.57 (± 4.08)	31.46 (± 53.76)	5.49 (± 9.44)
Cumulative impacts - Centralised mgmt.	12.99 (± 21.06)	5.64 (± 0.81)	1.25 (± 0.64)	0.01 (± 0.02)	5.15 (± 6.7)	2.74 (± 4.24)	37.02 (± 63.42)	7.4 (± 12.56)
Cumulative impacts - FewMPA	10.36 (± 16.51)	5.75 (± 3.22)	0.36 (± 0.51)	0 (± 0)	5.53 (± 7.14)	0.8 (± 1.24)	17.39 (± 29.21)	4 (± 6.74)
Cumulative impacts - Fragmented mgmt	12.81 (± 20.78)	5.25 (± 1.18)	1.07 (± 0.4)	0.01 (± 0.02)	5.15 (± 6.71)	2.74 (± 4.27)	35.31 (± 60.79)	5.34 (± 9.02)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
Cumulative impacts - ManyMPA	13.48 (± 21.89)	2.85 (± 1.73)	14.77 (± 21.01)	0.02 (± 0.02)	4.29 (± 5.51)	3.33 (± 5.15)	0.83 (± 1.34)	10.59 (± 17.61)
Cumulative impacts - Seasons	13.06 (± 21.2)	3.48 (± 2.16)	15.36 (± 22.24)	0.02 (± 0.03)	4.54 (± 5.95)	3.37 (± 5.2)	18.83 (± 32.34)	7.58 (± 12.75)
Cumulative impacts - SlowAssess	12.95 (± 20.98)	5.15 (± 0.52)	0.63 (± 0.3)	0.01 (± 0.01)	5.17 (± 6.73)	2.75 (± 4.24)	40.36 (± 68.97)	6.69 (± 11.47)
Cumulative impacts - IM	5.38 (± 7.89)	1.61 (± 0.46)	37.08 (± 56.95)	0 (± 0)	8.57 (± 12.48)	2.9 (± 4.46)	12.39 (± 20.8)	8.21 (± 13.2)
Expanded LTL fishery - IM	15.34 (± 25.14)	4.17 (± 1.54)	2.27 (± 1.74)	139.11 (± 226.06)	4.83 (± 6.29)	7.97 (± 12.27)	25.34 (± 43.42)	10.86 (± 18.44)
New mesopelgic fishery - IM	15.33 (± 25.15)	3.91 (± 1.97)	1.73 (± 1.86)	139.23 (± 225.95)	4.83 (± 6.3)	7.99 (± 12.25)	25.28 (± 43.47)	9.47 (± 16.02)
Extreme climate events - IM	15.57 (± 25.54)	5.06 (± 1.98)	0.14 (± 0.02)	109.97 (± 180.14)	4.77 (± 6.21)	6.69 (± 10.17)	18.82 (± 32.25)	8.13 (± 13.87)
Blooms - IM	15.23 (± 24.95)	4.96 (± 2.11)	0.15 (± 0.08)	122 (± 200.86)	4.79 (± 6.24)	6.81 (± 10.4)	17.93 (± 30.75)	8.59 (± 14.6)
Primary production regime shift - IM	15.19 (± 24.92)	5.16 (± 2.19)	3.14 (± 5.29)	102.33 (± 162.55)	4.79 (± 6.24)	8.24 (± 12.89)	27.38 (± 47.08)	16.41 (± 28.26)
Fish kills - IM	15.3 (± 25.04)	5.24 (± 2.35)	0.25 (± 0.3)	95.96 (± 154.51)	4.79 (± 6.24)	7.09 (± 10.9)	18.6 (± 31.87)	9.93 (± 17.07)
Range extensions - IM	15.04 (± 24.67)	6.04 (± 0.82)	1.47 (± 2.34)	124.65 (± 204.31)	4.84 (± 6.27)	6.92 (± 10.69)	17.82 (± 29.62)	5.7 (± 9.59)
Gear switching allowed - IM	15.83 (± 26)	4.52 (± 0.68)	4.85 (± 4.84)	167.43 (± 274.5)	4.28 (± 5.59)	8.75 (± 13.38)	29.79 (± 50.57)	16.2 (± 27.3)
High compliance - IM	15.26 (± 25.01)	4.66 (± 2.43)	2.45 (± 3.99)	78.18 (± 121.33)	4.81 (± 6.25)	7.73 (± 12.01)	22.04 (± 37.83)	14.85 (± 25.67)
Low Compliance - IM	15.52 (± 25.45)	4.45 (± 2.59)	1.57 (± 2.69)	97.62 (± 159.47)	4.89 (± 6.38)	6.64 (± 10.22)	17.42 (± 30)	6.5 (± 11.16)
Flexible fisher behaviour - IM	15.02 (± 24.58)	5.08 (± 1.86)	0.87 (± 0.91)	137.43 (± 224.56)	3.93 (± 5.1)	7.65 (± 11.72)	19.68 (± 33.62)	5.9 (± 9.85)
Increased fishing pressure drivers - IM	15.08 (± 24.68)	5.21 (± 2.3)	2.72 (± 4.53)	95.53 (± 154.86)	4.77 (± 6.2)	6.83 (± 10.44)	16.75 (± 28.66)	10.62 (± 18.26)
High Cost, Low Values - IM	15.79 (± 25.9)	1.96 (± 1.8)	5.33 (± 5.43)	186.83 (± 306.24)	3.97 (± 5.12)	9.47 (± 14.53)	2.36 (± 3.69)	4.81 (± 7.64)
Low Costs, High Values - IM	15.12 (± 25.27)	3.97 (± 2.86)	1.18 (± 0.87)	94.45 (± 149.76)	4.45 (± 6.48)	7.44 (± 12.03)	23.44 (± 39.93)	7.74 (± 13.41)
Standard Markets - IM	15.08 (± 24.68)	5.21 (± 2.3)	0.16 (± 0.11)	95.53 (± 154.86)	4.77 (± 6.2)	6.83 (± 10.44)	16.75 (± 28.66)	11.84 (± 20.38)
Technology Creep - IM	15.47 (± 25.36)	3.51 (± 1.52)	4.4 (± 4.25)	169.13 (± 276.9)	4.17 (± 5.43)	8.38 (± 12.79)	26.7 (± 45.72)	6.76 (± 11.08)
No Acclimation - 2010 coastal context - IM	8.71 (± 14.5)	3.3 (± 3.34)	0.09 (± 0.08)	12.05 (± 14.91)	2.6 (± 3.79)	6.69 (± 11.16)	17.32 (± 29.76)	3.01 (± 5.16)
No Acclimation - Cumulative impacts - SQ	21.65 (± 36.98)	17.59 (± 19.51)	0.01 (± 0.02)	2749.62 (± 4759.19)	1.55 (± 2.06)	5.63 (± 9.52)	37.06 (± 63.95)	2 (± 3.45)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	2.83 (± 0.96)	3.07 (± 1.63)	2.44 (± 2.08)	2.86 (± 2.78)	2.7 (± 3.16)	0.81 (± 0.65)	3.57 (± 2.2)	1.3 (± 0.21)
2010 coastal context - Cap ecosystem take	25.64 (± 42.76)	3.45 (± 4.78)	2.05 (± 1.52)	46.3 (± 77.63)	14.74 (± 23.79)	18.52 (± 31.79)	44.48 (± 54.35)	14.32 (± 22.85)
2010 coastal context - Centralised mgmt.	35.35 (± 59.79)	3.53 (± 4.82)	2.27 (± 1.38)	39.79 (± 66.02)	15.13 (± 23.69)	22.05 (± 37.73)	35.81 (± 41.23)	14.53 (± 23.17)
2010 coastal context - FewMPA	47.96 (± 76.88)	3.13 (± 4.18)	1.43 (± 1.81)	29.61 (± 48.9)	13.89 (± 21.75)	16.3 (± 27.95)	12.5 (± 18.08)	10.29 (± 16.39)
2010 coastal context - Fragmented mgmt	23.19 (± 38.51)	3.52 (± 4.86)	1.43 (± 1.11)	27.54 (± 45.37)	15.04 (± 23.55)	20.89 (± 35.75)	41.7 (± 37.24)	13.45 (± 21.34)
2010 coastal context - ManyMPA	4.79 (± 6.55)	3.05 (± 3.84)	1.97 (± 1.75)	15.63 (± 25.82)	14.54 (± 22.95)	2.6 (± 4.24)	44.08 (± 75.45)	10.42 (± 16.47)
2010 coastal context - Seasons	16.59 (± 27.16)	3.93 (± 5.46)	1.27 (± 0.91)	25.73 (± 41.62)	16.57 (± 25.98)	6.42 (± 11.03)	2.98 (± 3.71)	10.91 (± 17.37)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
2010 coastal context - SlowAssess	10.66 (± 17.34)	3.52 (± 4.73)	1.7 (± 1.42)	48.38 (± 80.63)	15.57 (± 24.35)	30.51 (± 52.3)	40.39 (± 61.44)	14.31 (± 22.8)
2010 coastal context - Integrated Mgmt (IM)	9.58 (± 13.64)	9.72 (± 14.35)	2.18 (± 1.34)	10.13 (± 15.68)	11.67 (± 15.43)	10.2 (± 17.34)	11.7 (± 16.94)	11.56 (± 17.9)
Cumulative impacts - 2010 Status Quo (SQ)	43.67 (± 73.32)	3.4 (± 4.66)	1.9 (± 2.38)	40.76 (± 67.97)	15.61 (± 24.52)	35.51 (± 60.94)	11.31 (± 9.4)	12.18 (± 19.41)
Cumulative impacts - Cap ecosystem take	31.81 (± 53.52)	3.39 (± 4.67)	1.86 (± 2.42)	36.74 (± 61.13)	15.31 (± 24.76)	62.48 (± 107.82)	9.58 (± 7.97)	12.31 (± 19.7)
Cumulative impacts - Centralised mgmt.	43.97 (± 74.74)	3.47 (± 4.72)	2.14 (± 2.66)	31.62 (± 51.95)	15.71 (± 24.67)	74.3 (± 128.07)	8.02 (± 6.64)	12.49 (± 19.98)
Cumulative impacts - FewMPA	59.46 (± 96.28)	3.07 (± 4.08)	1.73 (± 2.76)	23.54 (± 38.47)	14.42 (± 22.64)	55 (± 94.78)	2.99 (± 3.44)	8.85 (± 14.13)
Cumulative impacts - Fragmented mgmt	28.76 (± 48.21)	3.45 (± 4.75)	2.13 (± 2.76)	21.9 (± 35.68)	15.61 (± 24.52)	70.37 (± 121.35)	12.05 (± 12.54)	11.56 (± 18.41)
Cumulative impacts - ManyMPA	5.81 (± 8.32)	3 (± 3.76)	1.92 (± 1.76)	12.42 (± 20.32)	15.1 (± 23.89)	8.58 (± 14.55)	5.9 (± 9.7)	8.96 (± 14.21)
Cumulative impacts - Seasons	20.53 (± 34.05)	3.86 (± 5.33)	1.61 (± 1.79)	20.51 (± 32.69)	17.2 (± 27.05)	21.68 (± 37.4)	0.33 (± 0.26)	9.38 (± 14.98)
Cumulative impacts - SlowAssess	13.2 (± 21.72)	3.46 (± 4.63)	1.82 (± 2.38)	38.42 (± 63.47)	16.16 (± 25.35)	102.91 (± 177.42)	5.99 (± 7.46)	12.3 (± 19.66)
Cumulative impacts - IM	11.8 (± 17.14)	9.54 (± 14.04)	1.84 (± 2.02)	8.14 (± 12.26)	12.08 (± 16.09)	34.3 (± 58.93)	3.96 (± 5.44)	9.93 (± 15.44)
Expanded LTL fishery - IM	13.58 (± 22.46)	3.51 (± 4.76)	2.14 (± 1.97)	32.2 (± 53.35)	15.78 (± 24.73)	26.8 (± 45.95)	25.12 (± 27.59)	14.48 (± 23.1)
New mesopelgic fishery - IM	13.4 (± 22.62)	3.49 (± 4.77)	2.45 (± 2.49)	32.1 (± 53.44)	15.77 (± 24.74)	26.79 (± 45.96)	26.8 (± 26.85)	14.44 (± 23.14)
Extreme climate events - IM	22.84 (± 37.16)	3.44 (± 4.7)	2.58 (± 2.16)	10.6 (± 15.86)	15.01 (± 23.48)	18.18 (± 31.01)	61.35 (± 77.19)	13.94 (± 22.11)
Blooms - IM	28.03 (± 46.59)	3.51 (± 4.84)	3.05 (± 2.97)	9.37 (± 13.67)	15.03 (± 23.53)	13.22 (± 22.45)	62.94 (± 75.22)	14.26 (± 22.7)
Primary production regime shift - IM	21.22 (± 34.31)	3.67 (± 5.13)	2.89 (± 3.17)	47.55 (± 79.77)	15.12 (± 23.69)	32.65 (± 56.12)	20.98 (± 15.01)	13.7 (± 21.72)
Fish kills - IM	36 (± 59.88)	3.51 (± 4.85)	2.44 (± 1.66)	52.11 (± 87.58)	15.06 (± 23.59)	12.78 (± 21.69)	54.27 (± 66.16)	14.2 (± 22.58)
Range extensions - IM	28.62 (± 44.95)	3.47 (± 4.83)	2.7 (± 2.16)	44.16 (± 72.54)	15.55 (± 23.24)	13.54 (± 22.98)	62.52 (± 56.67)	13.78 (± 21.12)
Gear switching allowed - IM	14.99 (± 25.05)	3.77 (± 5.05)	1.74 (± 1.78)	36.16 (± 59.38)	15.91 (± 24.77)	36.93 (± 63.47)	7.04 (± 8.09)	12.71 (± 20.28)
High compliance - IM	18.79 (± 30.38)	3.5 (± 4.78)	2.73 (± 2.71)	32.16 (± 53.03)	15.25 (± 23.9)	19.1 (± 32.58)	33.29 (± 33.31)	13.83 (± 21.98)
Low Compliance - IM	12.53 (± 20.78)	3.42 (± 4.71)	2.37 (± 2.46)	15.03 (± 24.26)	15.22 (± 23.79)	12.06 (± 20.6)	62.88 (± 66.27)	13.69 (± 21.69)
Flexible fisher behaviour - IM	29.37 (± 48.8)	3.57 (± 4.88)	1.73 (± 0.76)	50.55 (± 84.7)	15.21 (± 23.81)	14.56 (± 24.76)	34.86 (± 43.63)	13.93 (± 22.13)
Increased fishing pressure drivers - IM	35.23 (± 58.55)	3.47 (± 4.76)	1.99 (± 1.41)	51.4 (± 86.29)	15.04 (± 23.55)	10.6 (± 17.9)	55.82 (± 71.24)	14.17 (± 22.51)
High Cost, Low Values - IM	3.92 (± 5.9)	3.37 (± 4.37)	1.1 (± 1.71)	18.13 (± 28.79)	16.24 (± 25.43)	5.3 (± 9.1)	2.87 (± 4.89)	10.54 (± 16.72)
Low Costs, High Values - IM	16.04 (± 26.98)	3.43 (± 4.79)	1.36 (± 1.03)	41.19 (± 68.98)	14.44 (± 24.05)	26.44 (± 45.68)	33.15 (± 37.66)	14.47 (± 23.19)
Standard Markets - IM	35.23 (± 58.55)	3.47 (± 4.76)	2.34 (± 1.67)	51.4 (± 86.29)	15.04 (± 23.55)	10.6 (± 17.9)	55.82 (± 71.24)	14.17 (± 22.51)
Technology Creep - IM	13.31 (± 21.39)	3.64 (± 4.97)	1.62 (± 1.34)	8.88 (± 13.97)	12.49 (± 19.15)	31.23 (± 53.68)	7.01 (± 6.37)	13.27 (± 21.15)
No Acclimation - 2010 coastal context - IM	35.76 (± 61.36)	3.3 (± 5.17)	2.08 (± 1.93)	52.59 (± 90.07)	14.8 (± 25.08)	10.84 (± 18.69)	18.19 (± 20.67)	1.51 (± 1.55)
No Acclimation - Cumulative impacts - SQ	145.96 (± 249.96)	1.15 (± 1.74)	2.66 (± 2.32)	279.83 (± 483.28)	21.31 (± 36.28)	11.23 (± 19.31)	50.23 (± 40.57)	1.74 (± 1.98)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
No Climate change - 2010 context - SQ	1.11 (± 1.45)	1.42 (± 0.31)	3.72 (± 2.48)	0.87 (± 0.37)	3.62 (± 3.39)	1.83 (± 0.8)	0.99 (± 0.43)	0.74 (± 0.26)
2010 coastal context - Cap ecosystem take	46.17 (± 67.42)	5.96 (± 8.7)	3.51 (± 1.71)	7.07 (± 9.88)	2.14 (± 2.58)	9.24 (± 14.23)	12.76 (± 20.28)	8.78 (± 14.82)
2010 coastal context - Centralised mgmt.	51.27 (± 74.92)	6 (± 8.73)	3.01 (± 1.67)	7.77 (± 11.2)	2.43 (± 2.87)	9.15 (± 13.82)	12.72 (± 20.48)	8.87 (± 14.96)
2010 coastal context - FewMPA	35.05 (± 50.69)	5.82 (± 8.46)	4.84 (± 1.67)	0.05 (± 0.06)	2.23 (± 2.71)	9.61 (± 14.61)	7.97 (± 12.77)	8.21 (± 13.84)
2010 coastal context - Fragmented mgmt	49.03 (± 72.48)	6 (± 8.73)	3.74 (± 1.05)	6.72 (± 9.41)	2.72 (± 3.5)	9.28 (± 14.06)	12.74 (± 20.53)	8.84 (± 14.93)
2010 coastal context - ManyMPA	4.02 (± 4.36)	6.1 (± 8.86)	4.07 (± 2.62)	6.91 (± 9.69)	2.24 (± 2.77)	5.69 (± 8.77)	12.86 (± 20.71)	7.45 (± 12.57)
2010 coastal context - Seasons	12.72 (± 18.75)	6.13 (± 8.91)	2 (± 0.99)	7.86 (± 10.72)	1.94 (± 2.32)	5.26 (± 8.02)	12.82 (± 20.65)	6.9 (± 11.64)
2010 coastal context - SlowAssess	50.39 (± 72.32)	6 (± 8.71)	3.47 (± 2.73)	8.51 (± 10.15)	2.59 (± 3.56)	9.42 (± 14.5)	12.77 (± 20.52)	8.94 (± 15.06)
2010 coastal context - Integrated Mgmt (IM)	46.66 (± 75)	6.47 (± 9.32)	3.63 (± 2.63)	12.94 (± 20.2)	13.29 (± 20.74)	13.6 (± 21.36)	13.83 (± 22)	13.9 (± 22.81)
Cumulative impacts - 2010 Status Quo (SQ)	35.42 (± 50.56)	5.97 (± 8.67)	3.21 (± 2.14)	3.07 (± 4.12)	2.36 (± 3.2)	10.1 (± 15.3)	8.38 (± 13.43)	7.87 (± 13.27)
Cumulative impacts - Cap ecosystem take	40.25 (± 59.89)	5.97 (± 8.71)	3.76 (± 1.59)	3.15 (± 4.26)	2.09 (± 2.8)	10.07 (± 15.5)	8.51 (± 13.46)	8.1 (± 13.67)
Cumulative impacts - Centralised mgmt.	44.7 (± 66.54)	6.02 (± 8.75)	3.78 (± 1.41)	3.45 (± 4.83)	2.37 (± 3.13)	9.97 (± 15.06)	8.48 (± 13.6)	8.18 (± 13.8)
Cumulative impacts - FewMPA	30.53 (± 45.06)	5.84 (± 8.47)	1.67 (± 1.16)	0.02 (± 0.03)	2.17 (± 2.94)	10.48 (± 15.92)	5.32 (± 8.48)	7.57 (± 12.77)
Cumulative impacts - Fragmented mgmt	42.79 (± 64.34)	6.01 (± 8.75)	3.18 (± 1.53)	2.99 (± 4.05)	2.69 (± 3.78)	10.12 (± 15.31)	8.49 (± 13.63)	8.16 (± 13.77)
Cumulative impacts - ManyMPA	3.26 (± 3.41)	6.12 (± 8.88)	3.77 (± 1)	3.08 (± 4.17)	2.2 (± 3)	6.2 (± 9.56)	8.57 (± 13.75)	6.87 (± 11.6)
Cumulative impacts - Seasons	11.09 (± 16.65)	6.15 (± 8.93)	3.32 (± 0.77)	3.51 (± 4.61)	1.9 (± 2.52)	5.73 (± 8.74)	8.55 (± 13.71)	6.37 (± 10.74)
Cumulative impacts - SlowAssess	43.88 (± 64.3)	6.02 (± 8.72)	3.25 (± 0.66)	3.85 (± 4.36)	2.6 (± 3.82)	10.27 (± 15.8)	8.52 (± 13.62)	8.25 (± 13.9)
Cumulative impacts - IM	10.23 (± 16.53)	5.49 (± 7.6)	4.31 (± 0.35)	5.36 (± 9.03)	13.62 (± 21.94)	14.81 (± 23.28)	9.05 (± 14.75)	12.81 (± 21.05)
Expanded LTL fishery - IM	53.59 (± 79.72)	6.05 (± 8.8)	2.86 (± 1.11)	8.37 (± 11.89)	1.72 (± 1.94)	9.53 (± 14.47)	12.94 (± 20.85)	8.87 (± 14.97)
New mesopelgic fishery - IM	53.09 (± 80.18)	6.05 (± 8.8)	3.18 (± 2.59)	8.36 (± 11.9)	1.73 (± 1.94)	9.56 (± 14.46)	12.94 (± 20.85)	8.87 (± 14.97)
Extreme climate events - IM	44.51 (± 63.26)	5.95 (± 8.65)	3.99 (± 2.17)	7.31 (± 10.14)	2.42 (± 3.23)	9.54 (± 14.52)	12.55 (± 20.21)	8.56 (± 14.43)
Blooms - IM	41.41 (± 58.49)	5.96 (± 8.67)	4.11 (± 1.63)	6.96 (± 9.76)	2.43 (± 3.39)	9.39 (± 14.24)	12.58 (± 20.26)	8.56 (± 14.44)
Primary production regime shift - IM	59.87 (± 90.42)	6.13 (± 8.96)	4.15 (± 2.37)	15.71 (± 24.93)	2.13 (± 2.88)	9.12 (± 13.78)	13.4 (± 21.69)	9.37 (± 15.84)
Fish kills - IM	44.09 (± 62.78)	5.97 (± 8.68)	3.49 (± 2.13)	7.13 (± 10.26)	2.5 (± 3.14)	9.22 (± 13.97)	12.62 (± 20.32)	8.6 (± 14.5)
Range extensions - IM	44.86 (± 58.98)	6.21 (± 8.5)	3.98 (± 0.88)	7.73 (± 9.75)	2.32 (± 2.46)	9.2 (± 14.21)	12.56 (± 20.34)	8.67 (± 14.43)
Gear switching allowed - IM	57.61 (± 85.49)	6.15 (± 8.94)	2.31 (± 2.01)	7.28 (± 10.2)	1.95 (± 2.36)	5.71 (± 8.77)	12.83 (± 20.66)	8.93 (± 15.06)
High compliance - IM	50.11 (± 72.58)	6 (± 8.74)	4.33 (± 2.51)	8.23 (± 11.72)	2.19 (± 2.25)	9.42 (± 14.31)	12.76 (± 20.57)	8.9 (± 15.01)
Low Compliance - IM	36.88 (± 54.25)	5.95 (± 8.64)	4.11 (± 1.71)	6.63 (± 9.54)	1.96 (± 2.39)	9.72 (± 14.75)	12.6 (± 20.31)	8.86 (± 14.96)
Flexible fisher behaviour - IM	46.95 (± 67.27)	5.99 (± 8.71)	2.11 (± 0.75)	7.19 (± 10.14)	2.54 (± 3.36)	7.85 (± 11.9)	12.57 (± 20.25)	8.77 (± 14.78)
Increased fishing pressure drivers - IM	40.75 (± 56.81)	5.96 (± 8.65)	3.98 (± 2.13)	6.88 (± 9.57)	2.42 (± 2.95)	9.26 (± 14.04)	12.56 (± 20.23)	8.53 (± 14.37)
High Cost, Low Values - IM	3.67 (± 4.75)	6.15 (± 8.94)	1.18 (± 0.32)	6.94 (± 10.09)	2.02 (± 2.58)	5.63 (± 8.64)	12.87 (± 20.73)	7.12 (± 12)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
Low Costs, High Values - IM	51.59 (± 78.08)	5.96 (± 8.74)	1.84 (± 0.24)	7.26 (± 10.19)	1.86 (± 2.21)	9.22 (± 14.41)	12.96 (± 20.34)	9.04 (± 15.26)
Standard Markets - IM	40.75 (± 56.81)	5.96 (± 8.65)	4.52 (± 3.21)	6.88 (± 9.57)	2.42 (± 2.95)	9.26 (± 14.04)	12.56 (± 20.23)	8.53 (± 14.37)
Technology Creep - IM	51.11 (± 75.18)	6.09 (± 8.84)	3.11 (± 2.49)	6.68 (± 9.51)	2.5 (± 2.88)	8.24 (± 12.69)	12.97 (± 20.89)	9.07 (± 15.3)
No Acclimation - 2010 coastal context - IM	4.8 (± 3.79)	0.8 (± 0.65)	0.73 (± 0.56)	1.29 (± 1.23)	2.61 (± 2.37)	9.1 (± 14.99)	1.5 (± 2.35)	0.67 (± 1.12)
No Acclimation - Cumulative impacts - SQ	22.68 (± 13.57)	0.84 (± 0.71)	0.59 (± 0.43)	2.46 (± 3.65)	0.62 (± 0.35)	6.18 (± 9.88)	1.38 (± 2.14)	0.42 (± 0.7)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
No Climate change - 2010 context - SQ	1.47 (± 1.5)	1.44 (± 0.27)	1.53 (± 0.3)	1.66 (± 0.89)	1.52 (± 0.6)	0.65 (± 0.09)	1.13 (± 0.05)	0.14 (± 0.1)
2010 coastal context - Cap ecosystem take	38.36 (± 57.4)	50 (± 83.47)	12.73 (± 19.9)	16.64 (± 26.71)	9.35 (± 15.91)	0.37 (± 0.1)	0.81 (± 0.55)	4.95 (± 8.43)
2010 coastal context - Centralised mgmt.	35.08 (± 52.63)	49.54 (± 83.36)	13.05 (± 20.87)	16.53 (± 26.95)	0.14 (± 0.15)	0.29 (± 0.07)	0.81 (± 0.55)	4.94 (± 8.44)
2010 coastal context - FewMPA	37.02 (± 57.08)	50.55 (± 85.05)	5.97 (± 9.52)	14.48 (± 23.49)	13.51 (± 11.85)	0.23 (± 0.05)	0.53 (± 0.35)	4.95 (± 8.46)
2010 coastal context - Fragmented mgmt	34.4 (± 51.95)	49.66 (± 83.57)	13.16 (± 21.15)	16.49 (± 26.89)	0.09 (± 0.08)	0.29 (± 0.07)	0.8 (± 0.53)	4.94 (± 8.44)
2010 coastal context - ManyMPA	40.21 (± 63.18)	49.53 (± 83.35)	14.95 (± 23.9)	16.53 (± 26.94)	0.77 (± 0.74)	0.3 (± 0.08)	0.84 (± 0.56)	4.94 (± 8.45)
2010 coastal context - Seasons	32.36 (± 48.75)	49.9 (± 83.98)	14.92 (± 23.84)	16.59 (± 27.04)	0.76 (± 0.74)	0.3 (± 0.08)	0.84 (± 0.56)	4.94 (± 8.44)
2010 coastal context - SlowAssess	35.06 (± 53.63)	49.65 (± 83.54)	12.98 (± 20.63)	16.6 (± 26.99)	0.55 (± 0.86)	0.34 (± 0.15)	0.99 (± 0.87)	4.94 (± 8.44)
2010 coastal context - Integrated Mgmt (IM)	38.25 (± 57.27)	48.38 (± 81.28)	15.36 (± 24.14)	16.04 (± 24.42)	1.5 (± 1.28)	0.45 (± 0.12)	0.66 (± 0.44)	16.15 (± 27.78)
Cumulative impacts - 2010 Status Quo (SQ)	35.84 (± 54.93)	50.49 (± 84.94)	7.44 (± 11.86)	15.15 (± 24.62)	85.11 (± 147.41)	0.27 (± 0.06)	0.62 (± 0.41)	4.94 (± 8.44)
Cumulative impacts - Cap ecosystem take	37.36 (± 55.88)	50.7 (± 84.62)	7.87 (± 12.27)	15.38 (± 24.59)	0.09 (± 0.16)	0.34 (± 0.09)	0.77 (± 0.39)	4.96 (± 8.43)
Cumulative impacts - Centralised mgmt.	34.15 (± 51.26)	50.23 (± 84.51)	8.06 (± 12.88)	15.27 (± 24.81)	0 (± 0)	0.27 (± 0.06)	0.62 (± 0.41)	4.94 (± 8.44)
Cumulative impacts - FewMPA	36.04 (± 55.59)	51.26 (± 86.23)	3.69 (± 5.88)	13.37 (± 21.63)	0.01 (± 0.01)	0.21 (± 0.04)	0.41 (± 0.26)	4.95 (± 8.46)
Cumulative impacts - Fragmented mgmt	33.49 (± 50.58)	50.36 (± 84.72)	8.13 (± 13.05)	15.23 (± 24.76)	0.03 (± 0.05)	0.27 (± 0.06)	0.62 (± 0.4)	4.94 (± 8.44)
Cumulative impacts - ManyMPA	39.15 (± 61.52)	50.22 (± 84.5)	9.23 (± 14.75)	15.27 (± 24.8)	0.02 (± 0.03)	0.27 (± 0.07)	0.64 (± 0.42)	4.94 (± 8.45)
Cumulative impacts - Seasons	31.5 (± 47.48)	50.6 (± 85.14)	9.21 (± 14.71)	15.32 (± 24.9)	0.02 (± 0.03)	0.28 (± 0.07)	0.64 (± 0.42)	4.94 (± 8.44)
Cumulative impacts - SlowAssess	34.15 (± 52.22)	50.35 (± 84.69)	8.01 (± 12.73)	15.33 (± 24.85)	0.02 (± 0.01)	0.31 (± 0.13)	0.76 (± 0.66)	4.94 (± 8.44)
Cumulative impacts - IM	13.88 (± 22.75)	15.16 (± 23.95)	9.48 (± 14.9)	14.85 (± 22.46)	0.01 (± 0.01)	0.41 (± 0.11)	0.47 (± 0.36)	16.15 (± 27.79)
Expanded LTL fishery - IM	37.98 (± 56.73)	50.11 (± 84.31)	13.68 (± 21.89)	16.83 (± 27.45)	0.2 (± 0.2)	0.29 (± 0.07)	0.82 (± 0.55)	4.93 (± 8.43)
New mesopelgic fishery - IM	38.1 (± 56.64)	50.1 (± 84.32)	13.69 (± 21.88)	16.83 (± 27.45)	0.45 (± 0.61)	0.29 (± 0.07)	0.83 (± 0.57)	4.93 (± 8.43)
Extreme climate events - IM	32.55 (± 50.23)	49.88 (± 83.95)	11.85 (± 18.85)	16.45 (± 26.82)	0.08 (± 0.12)	0.29 (± 0.07)	0.8 (± 0.55)	4.94 (± 8.44)
Blooms - IM	31.44 (± 47.21)	49.87 (± 83.94)	12.02 (± 19.16)	16.44 (± 26.79)	0.06 (± 0.07)	0.29 (± 0.07)	0.8 (± 0.54)	4.94 (± 8.44)
Primary production regime shift - IM	27.9 (± 41.74)	50.53 (± 85.08)	15.12 (± 24.54)	18.04 (± 29.58)	0.28 (± 0.33)	0.86 (± 0.97)	0.86 (± 0.49)	4.94 (± 8.44)
Fish kills - IM	31.62 (± 47.46)	49.6 (± 83.46)	12.41 (± 19.84)	16.46 (± 26.83)	0.09 (± 0.1)	0.29 (± 0.07)	0.8 (± 0.54)	4.94 (± 8.44)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
Range extensions - IM	31.71 (± 48.87)	49.73 (± 83.83)	12.2 (± 19.59)	16.4 (± 26.84)	0.12 (± 0.15)	0.31 (± 0.1)	0.81 (± 0.55)	4.94 (± 8.44)
Gear switching allowed - IM	26.6 (± 39.23)	49.58 (± 83.43)	14.78 (± 23.62)	16.56 (± 26.99)	0.76 (± 0.73)	0.29 (± 0.08)	0.84 (± 0.56)	4.94 (± 8.44)
High compliance - IM	34.55 (± 51.96)	49.51 (± 83.31)	13.32 (± 21.41)	16.55 (± 27)	0.15 (± 0.14)	0.29 (± 0.07)	0.81 (± 0.55)	4.94 (± 8.44)
Low Compliance - IM	32.07 (± 48.62)	49.8 (± 83.81)	11.8 (± 18.93)	16.5 (± 26.9)	0.01 (± 0.01)	0.29 (± 0.07)	0.77 (± 0.5)	4.94 (± 8.44)
Flexible fisher behaviour - IM	25.14 (± 37.95)	49.46 (± 83.23)	12.96 (± 20.69)	16.24 (± 26.48)	0.15 (± 0.15)	0.29 (± 0.07)	0.82 (± 0.55)	4.94 (± 8.44)
Increased fishing pressure drivers - IM	36.82 (± 56.41)	49.79 (± 83.79)	12.06 (± 19.22)	16.41 (± 26.74)	0.09 (± 0.12)	0.29 (± 0.07)	0.8 (± 0.55)	4.94 (± 8.44)
High Cost, Low Values - IM	36.53 (± 56.17)	49.71 (± 83.66)	14.97 (± 23.93)	16.6 (± 27.06)	0.77 (± 0.74)	0.3 (± 0.08)	0.84 (± 0.56)	4.94 (± 8.44)
Low Costs, High Values - IM	39.9 (± 58.39)	50.2 (± 83.15)	13.41 (± 20.58)	16.88 (± 26.68)	0.13 (± 0.13)	0.33 (± 0.06)	1.18 (± 0.66)	4.97 (± 8.41)
Standard Markets - IM	36.82 (± 56.41)	49.79 (± 83.79)	12.06 (± 19.22)	16.41 (± 26.74)	0.09 (± 0.12)	0.29 (± 0.07)	0.8 (± 0.55)	4.94 (± 8.44)
Technology Creep - IM	36.84 (± 56.21)	49.45 (± 83.22)	14.38 (± 22.95)	16.73 (± 27.27)	0.61 (± 0.68)	0.3 (± 0.07)	0.51 (± 0.07)	4.94 (± 8.44)
No Acclimation - 2010 coastal context - IM	4.41 (± 6.53)	5.91 (± 9.76)	1.45 (± 2.22)	1.97 (± 3.1)	0.04 (± 0.05)	0.14 (± 0.05)	0.4 (± 0.32)	2.31 (± 3.94)
No Acclimation - Cumulative impacts - SQ	12.46 (± 15.16)	20.06 (± 34.25)	1.13 (± 1.77)	2.05 (± 3.36)	0.04 (± 0.07)	0.09 (± 0.03)	0.46 (± 0.23)	0.71 (± 1.19)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
No Climate change - 2010 context - SQ	1.15 (± 0.27)	1.08 (± 0.19)	1.5 (± 0.28)	1.31 (± 0.35)	0.96 (± 0.03)	0.98 (± 0.19)	1.46 (± 0.31)	3.47 (± 0.17)
2010 coastal context - Cap ecosystem take	2.7 (± 4.05)	6.08 (± 9.28)	14.22 (± 23.14)	7.43 (± 11.9)	14.54 (± 23.57)	21.64 (± 35.78)	18.58 (± 30.24)	29.23 (± 44.39)
2010 coastal context - Centralised mgmt.	2.69 (± 4.1)	5.96 (± 9.38)	14.4 (± 23.55)	7.53 (± 12.11)	14.89 (± 24.58)	21.48 (± 35.69)	18.74 (± 30.3)	29.73 (± 43.94)
2010 coastal context - FewMPA	2.64 (± 4.03)	5.95 (± 9.38)	10.91 (± 17.85)	4.05 (± 6.52)	1.49 (± 2.45)	22.22 (± 36.94)	17.22 (± 27.84)	29.76 (± 43.99)
2010 coastal context - Fragmented mgmt	2.69 (± 4.11)	5.96 (± 9.38)	14.44 (± 23.64)	7.61 (± 12.27)	15.15 (± 25.08)	21.45 (± 35.64)	18.75 (± 30.32)	29.73 (± 43.95)
2010 coastal context - ManyMPA	2.71 (± 4.13)	5.96 (± 9.39)	15.02 (± 24.56)	8.14 (± 13.1)	23.34 (± 38.67)	21.2 (± 35.23)	18.81 (± 30.4)	29.81 (± 44.06)
2010 coastal context - Seasons	2.73 (± 4.16)	5.96 (± 9.38)	14.86 (± 24.28)	7.91 (± 12.69)	19.71 (± 32.37)	21.22 (± 35.27)	18.81 (± 30.41)	29.73 (± 43.94)
2010 coastal context - SlowAssess	2.92 (± 3.95)	5.96 (± 9.38)	14.43 (± 23.43)	8.92 (± 11.35)	14.59 (± 23.94)	21.44 (± 35.77)	18.77 (± 30.21)	28.93 (± 44.65)
2010 coastal context - Integrated Mgmt (IM)	17.27 (± 27.68)	17.53 (± 28.32)	17.74 (± 29.01)	17.94 (± 29.7)	18.39 (± 30.17)	18.43 (± 31.01)	19.5 (± 30.95)	20.83 (± 30.65)
Cumulative impacts - 2010 Status Quo (SQ)	2.29 (± 3.49)	5.96 (± 9.39)	10.76 (± 17.59)	4.86 (± 7.84)	0.75 (± 1.23)	22.43 (± 37.28)	17.19 (± 27.79)	29.73 (± 43.94)
Cumulative impacts - Cap ecosystem take	2.33 (± 3.5)	6.08 (± 9.28)	10.96 (± 17.84)	5 (± 8.05)	0.8 (± 1.29)	22.41 (± 37.06)	17.19 (± 27.99)	29.22 (± 44.39)
Cumulative impacts - Centralised mgmt.	2.33 (± 3.55)	5.96 (± 9.39)	11.09 (± 18.16)	5.07 (± 8.19)	0.82 (± 1.34)	22.24 (± 36.96)	17.34 (± 28.04)	29.73 (± 43.94)
Cumulative impacts - FewMPA	2.28 (± 3.49)	5.96 (± 9.38)	8.41 (± 13.77)	2.73 (± 4.41)	0.08 (± 0.13)	23.02 (± 38.25)	15.94 (± 25.77)	29.76 (± 43.98)
Cumulative impacts - Fragmented mgmt	2.33 (± 3.56)	5.96 (± 9.39)	11.12 (± 18.23)	5.12 (± 8.3)	0.83 (± 1.37)	22.22 (± 36.91)	17.35 (± 28.06)	29.73 (± 43.94)
Cumulative impacts - ManyMPA	2.35 (± 3.57)	5.96 (± 9.39)	11.57 (± 18.94)	5.48 (± 8.86)	1.28 (± 2.11)	21.96 (± 36.48)	17.4 (± 28.14)	29.81 (± 44.06)
Cumulative impacts - Seasons	2.37 (± 3.6)	5.96 (± 9.39)	11.44 (± 18.73)	5.32 (± 8.58)	1.08 (± 1.77)	21.98 (± 36.53)	17.4 (± 28.14)	29.73 (± 43.93)
Cumulative impacts - SlowAssess	2.53 (± 3.42)	5.96 (± 9.39)	11.12 (± 18.07)	5.94 (± 7.71)	0.8 (± 1.31)	22.2 (± 37.04)	17.37 (± 27.96)	29.65 (± 44.01)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
Cumulative impacts - IM	14.93 (± 23.95)	17.54 (± 28.33)	13.67 (± 22.37)	12.08 (± 20.07)	1.01 (± 1.65)	19.09 (± 32.11)	18.04 (± 28.64)	20.47 (± 30.97)
Expanded LTL fishery - IM	2.71 (± 4.13)	5.97 (± 9.4)	14.66 (± 23.97)	7.82 (± 12.58)	15.83 (± 26.15)	21.41 (± 35.58)	18.8 (± 30.39)	29.78 (± 44.01)
New mesopelgic fishery - IM	2.71 (± 4.13)	5.97 (± 9.4)	14.67 (± 23.96)	7.83 (± 12.57)	15.87 (± 26.11)	21.41 (± 35.58)	18.8 (± 30.39)	29.78 (± 44.01)
Extreme climate events - IM	2.64 (± 4.02)	5.96 (± 9.39)	13.91 (± 22.71)	7.28 (± 11.69)	13.4 (± 22.05)	21.69 (± 36.05)	18.58 (± 30.03)	29.73 (± 43.95)
Blooms - IM	2.64 (± 4.03)	5.96 (± 9.39)	13.95 (± 22.79)	7.3 (± 11.73)	13.59 (± 22.4)	21.67 (± 36.01)	18.58 (± 30.03)	29.73 (± 43.95)
Primary production regime shift - IM	5.12 (± 8.31)	5.96 (± 9.38)	16.52 (± 27.24)	38.9 (± 66.46)	16.28 (± 27.07)	18.91 (± 31.24)	21.37 (± 34.87)	15.51 (± 19.31)
Fish kills - IM	2.66 (± 4.06)	5.96 (± 9.38)	14.13 (± 23.09)	7.33 (± 11.78)	14.09 (± 23.29)	21.59 (± 35.89)	18.62 (± 30.1)	29.73 (± 43.94)
Range extensions - IM	2.67 (± 4.05)	5.96 (± 9.38)	14.09 (± 23.03)	7.39 (± 11.87)	13.42 (± 22.11)	21.62 (± 35.93)	18.63 (± 30.11)	29.74 (± 43.95)
Gear switching allowed - IM	2.75 (± 4.19)	5.96 (± 9.38)	14.73 (± 24.08)	7.99 (± 12.86)	19.66 (± 32.31)	21.23 (± 35.29)	18.81 (± 30.42)	29.74 (± 43.96)
High compliance - IM	2.7 (± 4.12)	5.96 (± 9.38)	14.5 (± 23.72)	7.65 (± 12.33)	15.38 (± 25.49)	21.43 (± 35.61)	18.76 (± 30.34)	29.73 (± 43.94)
Low Compliance - IM	2.64 (± 4.04)	5.96 (± 9.39)	13.8 (± 22.6)	7.3 (± 11.8)	13.24 (± 21.86)	21.7 (± 36.06)	18.56 (± 30.01)	29.73 (± 43.93)
Flexible fisher behaviour - IM	2.7 (± 4.12)	5.96 (± 9.38)	14.39 (± 23.52)	7.48 (± 12.03)	14.98 (± 24.72)	21.48 (± 35.71)	18.73 (± 30.27)	29.73 (± 43.94)
Increased fishing pressure drivers - IM	2.65 (± 4.03)	5.96 (± 9.38)	13.97 (± 22.81)	7.23 (± 11.6)	13.63 (± 22.47)	21.66 (± 36)	18.58 (± 30.03)	29.73 (± 43.94)
High Cost, Low Values - IM	2.74 (± 4.16)	5.96 (± 9.39)	14.83 (± 24.24)	8.11 (± 13.06)	22.04 (± 36.31)	21.21 (± 35.25)	18.81 (± 30.41)	29.76 (± 43.99)
Low Costs, High Values - IM	2.74 (± 4.07)	6.2 (± 9.18)	14.48 (± 23.47)	7.63 (± 12.21)	15.46 (± 24.67)	21.62 (± 35.57)	18.57 (± 30.45)	29.81 (± 43.88)
Standard Markets - IM	2.65 (± 4.03)	5.96 (± 9.38)	13.97 (± 22.81)	7.23 (± 11.6)	13.63 (± 22.47)	21.66 (± 36)	18.58 (± 30.03)	29.73 (± 43.94)
Technology Creep - IM	2.75 (± 4.19)	5.96 (± 9.39)	14.41 (± 23.56)	7.97 (± 12.81)	16.54 (± 27.19)	21.27 (± 35.36)	18.83 (± 30.44)	29.73 (± 43.94)
No Acclimation - 2010 coastal context - IM	1.25 (± 1.87)	4.09 (± 6.32)	9.62 (± 15.36)	5.01 (± 7.79)	9.33 (± 15.18)	14.84 (± 24.31)	8.4 (± 13.63)	13.79 (± 20.11)
No Acclimation - Cumulative impacts - SQ	0.21 (± 0.26)	1.4 (± 2.08)	7.49 (± 12.14)	1.99 (± 3.06)	6.74 (± 11.45)	17.6 (± 28.09)	8.02 (± 13.21)	19.67 (± 28.83)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
No Climate change - 2010 context - SQ	2.43 (± 1.96)	1.52 (± 0.1)	0.93 (± 0.28)	0.88 (± 0.26)	0.98 (± 0.35)	1.7 (± 0.99)	1.14 (± 0.09)	4.14 (± 0.95)
2010 coastal context - Cap ecosystem take	31.67 (± 47.83)	12.24 (± 19.54)	20.01 (± 31.74)	51.15 (± 83.12)	28.96 (± 48.59)	25.19 (± 41.83)	21.6 (± 35.45)	8.03 (± 11.11)
2010 coastal context - Centralised mgmt.	33.02 (± 46.88)	12.31 (± 19.46)	19.52 (± 31.92)	51.38 (± 82.57)	28.75 (± 47.93)	25.22 (± 41.85)	21.53 (± 35.28)	8.31 (± 10.84)
2010 coastal context - FewMPA	33.93 (± 48.46)	10.97 (± 17.35)	20.23 (± 33.09)	52.47 (± 84.32)	28.91 (± 48.21)	25.23 (± 41.86)	21.8 (± 35.72)	8.39 (± 10.96)
2010 coastal context - Fragmented mgmt	33.03 (± 46.91)	12.31 (± 19.46)	19.51 (± 31.9)	51.53 (± 82.8)	29.09 (± 48.5)	25.06 (± 41.57)	21.5 (± 35.21)	8.31 (± 10.84)
2010 coastal context - ManyMPA	33.18 (± 46.95)	12.24 (± 19.36)	19.38 (± 31.7)	51.05 (± 82.05)	28.33 (± 47.23)	25.03 (± 41.53)	21.34 (± 34.97)	8.27 (± 10.79)
2010 coastal context - Seasons	33.36 (± 47.37)	12.24 (± 19.35)	19.38 (± 31.7)	51.04 (± 82.04)	28.37 (± 47.3)	25.08 (± 41.61)	21.37 (± 35.02)	8.27 (± 10.79)
2010 coastal context - SlowAssess	32.99 (± 46.88)	12.32 (± 19.47)	19.55 (± 31.98)	50.79 (± 83.19)	28.81 (± 48.03)	25.13 (± 41.82)	21.54 (± 35.26)	8.33 (± 10.83)
2010 coastal context - Integrated Mgmt (IM)	20.7 (± 31.68)	20.27 (± 32.87)	20.19 (± 33.81)	23.93 (± 31.8)	21.06 (± 34.79)	21.37 (± 35.39)	21.92 (± 35.77)	9. 73 (± 12.58)
Cumulative impacts - 2010 Status Quo (SQ)	33.76 (± 48.07)	10.93 (± 17.29)	21.08 (± 34.49)	52.36 (± 84.16)	31.29 (± 52.17)	25.46 (± 42.25)	22.68 (± 37.16)	8.57 (± 11.18)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
Cumulative impacts - Cap ecosystem take	32.43 (± 49.06)	10.86 (± 17.35)	21.44 (± 34)	51.91 (± 84.34)	31.01 (± 52.02)	25.41 (± 42.2)	22.59 (± 37.06)	8.25 (± 11.42)
Cumulative impacts - Centralised mgmt.	33.79 (± 48.11)	10.93 (± 17.28)	20.91 (± 34.2)	52.14 (± 83.78)	30.79 (± 51.31)	25.44 (± 42.22)	22.52 (± 36.9)	8.55 (± 11.14)
Cumulative impacts - FewMPA	34.73 (± 49.72)	9.74 (± 15.41)	21.67 (± 35.45)	53.25 (± 85.56)	30.96 (± 51.62)	25.45 (± 42.23)	22.8 (± 37.35)	8.63 (± 11.26)
Cumulative impacts - Fragmented mgmt	33.81 (± 48.13)	10.93 (± 17.27)	20.9 (± 34.17)	52.29 (± 84.02)	31.16 (± 51.92)	25.28 (± 41.94)	22.48 (± 36.82)	8.55 (± 11.14)
Cumulative impacts - ManyMPA	33.95 (± 48.17)	10.87 (± 17.19)	20.76 (± 33.97)	51.81 (± 83.26)	30.34 (± 50.57)	25.25 (± 41.9)	22.32 (± 36.57)	8.5 (± 11.09)
Cumulative impacts - Seasons	34.14 (± 48.6)	10.87 (± 17.18)	20.76 (± 33.96)	51.8 (± 83.24)	30.38 (± 50.64)	25.3 (± 41.98)	22.35 (± 36.62)	8.51 (± 11.09)
Cumulative impacts - SlowAssess	33.8 (± 48.06)	10.94 (± 17.29)	20.95 (± 34.26)	51.54 (± 84.41)	30.86 (± 51.43)	25.35 (± 42.19)	22.52 (± 36.87)	8.57 (± 11.13)
Cumulative impacts - IM	28.73 (± 45.44)	18 (± 29.19)	21.64 (± 36.22)	24.28 (± 32.27)	22.55 (± 37.24)	21.56 (± 35.7)	22.93 (± 37.41)	8.42 (± 10.11)
Expanded LTL fishery - IM	33.13 (± 46.96)	12.38 (± 19.58)	19.56 (± 31.99)	51.43 (± 82.66)	28.7 (± 47.85)	25.08 (± 41.61)	21.48 (± 35.19)	8.29 (± 10.81)
New mesopelgic fishery - IM	33.13 (± 46.96)	12.38 (± 19.58)	19.55 (± 31.99)	51.43 (± 82.66)	28.7 (± 47.86)	25.07 (± 41.61)	21.48 (± 35.19)	8.29 (± 10.81)
Extreme climate events - IM	33 (± 46.85)	12.32 (± 19.48)	19.71 (± 32.25)	51.61 (± 82.95)	29.27 (± 48.81)	25.25 (± 41.91)	21.69 (± 35.56)	8.34 (± 10.88)
Blooms - IM	33.01 (± 46.87)	12.32 (± 19.47)	19.68 (± 32.2)	51.65 (± 83.03)	29.42 (± 49.07)	25.24 (± 41.88)	21.67 (± 35.52)	8.33 (± 10.88)
Primary production regime shift - IM	19.49 (± 23.71)	12.55 (± 19.88)	19.44 (± 31.79)	30.4 (± 46.22)	28.55 (± 47.57)	22.35 (± 36.87)	22.01 (± 36.1)	8.55 (± 11.26)
Fish kills - IM	32.99 (± 46.84)	12.32 (± 19.47)	19.61 (± 32.08)	51.52 (± 82.8)	29.06 (± 48.45)	25.29 (± 41.97)	21.64 (± 35.47)	8.33 (± 10.86)
Range extensions - IM	32.79 (± 46.48)	12.32 (± 19.48)	19.63 (± 32.13)	51.55 (± 82.85)	29.02 (± 48.38)	25.21 (± 41.83)	21.62 (± 35.42)	8.33 (± 10.86)
Gear switching allowed - IM	33.39 (± 47.33)	12.24 (± 19.36)	19.34 (± 31.64)	51.09 (± 82.11)	28.35 (± 47.27)	25.07 (± 41.6)	21.37 (± 35.01)	8.27 (± 10.8)
High compliance - IM	33.02 (± 46.9)	12.3 (± 19.45)	19.5 (± 31.88)	51.31 (± 82.44)	28.66 (± 47.74)	25.06 (± 41.58)	21.46 (± 35.15)	8.31 (± 10.83)
Low Compliance - IM	33.01 (± 46.87)	12.32 (± 19.48)	19.73 (± 32.26)	51.64 (± 82.98)	29.33 (± 48.89)	25.27 (± 41.92)	21.72 (± 35.58)	8.34 (± 10.88)
Flexible fisher behaviour - IM	33.04 (± 46.91)	12.31 (± 19.47)	19.53 (± 31.94)	51.45 (± 82.68)	28.93 (± 48.24)	25.1 (± 41.66)	21.53 (± 35.28)	8.31 (± 10.85)
Increased fishing pressure drivers - IM	32.99 (± 46.85)	12.32 (± 19.47)	19.67 (± 32.19)	51.6 (± 82.94)	29.22 (± 48.73)	25.23 (± 41.87)	21.68 (± 35.53)	8.34 (± 10.88)
High Cost, Low Values - IM	33.37 (± 47.39)	12.25 (± 19.37)	19.38 (± 31.71)	51.07 (± 82.07)	28.32 (± 47.23)	25.05 (± 41.57)	21.35 (± 34.98)	8.27 (± 10.8)
Low Costs, High Values - IM	32.35 (± 47.32)	12.16 (± 19.61)	20.34 (± 31.29)	50.71 (± 83.29)	28.7 (± 48.45)	25.14 (± 41.79)	21.51 (± 35.36)	7.72 (± 11.36)
Standard Markets - IM	32.99 (± 46.85)	12.32 (± 19.47)	19.67 (± 32.19)	51.6 (± 82.94)	29.22 (± 48.73)	25.23 (± 41.87)	21.68 (± 35.53)	8.34 (± 10.88)
Technology Creep - IM	33.25 (± 47.22)	12.29 (± 19.43)	19.43 (± 31.8)	51.24 (± 82.37)	28.57 (± 47.65)	25.09 (± 41.64)	21.43 (± 35.12)	8.29 (± 10.81)
No Acclimation - 2010 coastal context - IM	45.61 (± 64.53)	5.73 (± 8.71)	18.39 (± 29.52)	23.39 (± 38.44)	13.9 (± 22.01)	23.6 (± 39.28)	20.54 (± 33.11)	8.44 (± 4.53)
No Acclimation - Cumulative impacts - SQ	58.52 (± 65.86)	3.59 (± 5.08)	19.08 (± 27.19)	58.92 (± 92.73)	19.16 (± 30.94)	27.89 (± 46.47)	20.32 (± 32.88)	3.69 (± 1.67)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	2.18 (± 0.7)	0.7 (± 0.23)	106.33 (± 86.88)	29.89 (± 13.06)
2010 coastal context - Cap ecosystem take	143.76 (± 238.15)	67.8 (± 114.11)	123.46 (± 209.09)	14.29 (± 17.62)
2010 coastal context - Centralised mgmt.	143.44 (± 235.69)	67.67 (± 113.51)	193.23 (± 329.97)	20.79 (± 28.73)
2010 coastal context - FewMPA	148.98 (± 244.86)	69.72 (± 116.97)	198.46 (± 338.86)	21.01 (± 28.98)
2010 coastal context - Fragmented mgmt	143.28 (± 235.32)	67.6 (± 113.38)	193.56 (± 330.55)	20.83 (± 28.79)
2010 coastal context - ManyMPA	141.17 (± 232)	66.79 (± 112.05)	188.6 (± 322.03)	20.37 (± 28.11)
2010 coastal context - Seasons	141.3 (± 232.22)	66.86 (± 112.17)	188.62 (± 322.06)	20.37 (± 28.1)
2010 coastal context - SlowAssess	144.02 (± 235.97)	67.86 (± 113.48)	195.06 (± 333.12)	20.96 (± 28.96)
2010 coastal context - Integrated Mgmt (IM)	126.23 (± 206.9)	22.64 (± 37.75)	155.85 (± 213.47)	43.89 (± 36.77)
Cumulative impacts - 2010 Status Quo (SQ)	150.07 (± 246.61)	74.21 (± 124.48)	201.51 (± 344.09)	21.9 (± 30.24)
Cumulative impacts - Cap ecosystem take	148.36 (± 245.69)	73.77 (± 124.15)	127.83 (± 216.5)	14.94 (± 18.43)
Cumulative impacts - Centralised mgmt.	148.03 (± 243.14)	73.63 (± 123.5)	200.07 (± 341.66)	21.74 (± 30.05)
Cumulative impacts - FewMPA	153.75 (± 252.61)	75.87 (± 127.26)	205.49 (± 350.87)	21.97 (± 30.32)
Cumulative impacts - Fragmented mgmt	147.87 (± 242.77)	73.56 (± 123.36)	200.42 (± 342.27)	21.78 (± 30.12)
Cumulative impacts - ManyMPA	145.7 (± 239.34)	72.68 (± 121.9)	195.28 (± 333.44)	21.3 (± 29.41)
Cumulative impacts - Seasons	145.83 (± 239.57)	72.75 (± 122.04)	195.3 (± 333.47)	21.3 (± 29.39)
Cumulative impacts - SlowAssess	148.63 (± 243.43)	73.84 (± 123.46)	201.97 (± 344.93)	21.91 (± 30.3)
Cumulative impacts - IM	127.01 (± 208.12)	24.64 (± 41.07)	161.33 (± 221.06)	45.84 (± 38.38)
Expanded LTL fishery - IM	147.44 (± 242.25)	67.49 (± 113.21)	197.16 (± 336.66)	20.98 (± 28.98)
New mesopelgic fishery - IM	147.41 (± 242.28)	67.49 (± 113.21)	197.16 (± 336.66)	20.98 (± 28.98)
Extreme climate events - IM	145.6 (± 239.38)	68.27 (± 114.54)	193.76 (± 330.81)	20.87 (± 28.77)
Blooms - IM	145.45 (± 239.09)	68.19 (± 114.41)	193.01 (± 329.51)	20.82 (± 28.68)
Primary production regime shift - IM	155.86 (± 257.12)	81.04 (± 136.66)	194.3 (± 331.46)	21.33 (± 28.59)
Fish kills - IM	144.72 (± 237.82)	67.97 (± 114.02)	194.61 (± 332.32)	20.93 (± 28.91)
Range extensions - IM	144.93 (± 238.11)	68.04 (± 114.13)	192.99 (± 329.51)	20.8 (± 28.68)
Gear switching allowed - IM	141.33 (± 232.26)	66.87 (± 112.19)	188.53 (± 321.9)	20.37 (± 28.09)
High compliance - IM	143.09 (± 235.02)	67.54 (± 113.27)	195.82 (± 334.46)	21.02 (± 29.12)
Low Compliance - IM	145.73 (± 239.42)	68.3 (± 114.56)	194.82 (± 332.65)	20.99 (± 28.96)
Flexible fisher behaviour - IM	143.58 (± 235.97)	67.68 (± 113.55)	191.98 (± 327.8)	20.7 (± 28.56)
Increased fishing pressure drivers - IM	145.41 (± 239.04)	68.19 (± 114.41)	194.62 (± 332.31)	20.95 (± 28.9)
High Cost, Low Values - IM	141.22 (± 232.09)	66.84 (± 112.12)	188.45 (± 321.76)	20.36 (± 28.08)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
Low Costs, High Values - IM	142.1 (± 237.26)	67.4 (± 113.8)	52.3 (± 85.89)	7.64 (± 7.01)
Standard Markets - IM	145.41 (± 239.04)	68.19 (± 114.41)	194.62 (± 332.31)	20.95 (± 28.9)
Technology Creep - IM	141.93 (± 233.28)	67.19 (± 112.73)	189.48 (± 323.53)	20.47 (± 28.24)
No Acclimation - 2010 coastal context - IM	68.06 (± 60.63)	30.87 (± 51.88)	19324.8 (± 33469.69)	383.89 (± 661.18)
No Acclimation - Cumulative impacts - SQ	389.62 (± 410.83)	93.47 (± 156.84)	27984.01 (± 48469.59)	333.93 (± 577.89)

Table A. 3: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SE for each strategy-scenario combination under RCP 8.5. Biomass is relative to 2010 model values.

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	1.53 (± 0.47)	17.82 (± 23.26)	1.34 (± 1.46)	1.25 (± 0.82)	2.19 (± 1.39)	1.3 (± 0.42)	1.96 (± 1.75)
2010 coastal context - Cap ecosystem take	1.5 (± 0.41)	2.57 (± 0.72)	2.31 (± 0.12)	0.03 (± 0.02)	0.1 (± 0.07)	0.64 (± 0.18)	3.66 (± 0.54)
2010 coastal context - Centralised mgmt.	1.73 (± 0.01)	2.94 (± 0.33)	2.19 (± 0.06)	0.05 (± 0.03)	0.16 (± 0.09)	1.15 (± 0.39)	4.8 (± 1.32)
2010 coastal context - FewMPA	1.65 (± 0.09)	2.78 (± 1.88)	1.86 (± 0.31)	0 (± 0)	0 (± 0)	0.23 (± 0.06)	2.62 (± 0.48)
2010 coastal context - Fragmented mgmt	1.74 (± 0)	3.02 (± 0.27)	2.22 (± 0.11)	0.03 (± 0.03)	0.13 (± 0.14)	0.42 (± 0.11)	4.45 (± 1.5)
2010 coastal context - ManyMPA	1.73 (± 0)	1.29 (± 0.24)	1.24 (± 0)	1.45 (± 0.14)	1.73 (± 0.18)	1.19 (± 0.03)	1.28 (± 0.25)
2010 coastal context - Seasons	1.73 (± 0.01)	1.28 (± 0.21)	1.26 (± 0.02)	1.34 (± 0.21)	1.81 (± 0.03)	1.17 (± 0.03)	1.59 (± 0.22)
2010 coastal context - SlowAssess	1.74 (± 0.03)	2.85 (± 0.81)	2.12 (± 0.16)	0.33 (± 0.54)	0.52 (± 0.64)	0.46 (± 0.25)	4.68 (± 1.5)
2010 coastal context - Integrated Mgmt (IM)	1.2 (± 0.63)	3.9 (± 1.39)	0.82 (± 0.05)	3.19 (± 3.37)	1.53 (± 0.67)	2.13 (± 1.65)	1.01 (± 0.72)
Cumulative impacts - 2010 Status Quo (SQ)	1.72 (± 0.04)	5.06 (± 2.56)	2.08 (± 0.29)	0 (± 0)	0 (± 0)	0.08 (± 0.03)	3.3 (± 0.97)
Cumulative impacts - Cap ecosystem take	1.49 (± 0.42)	4.68 (± 3)	2.18 (± 0.29)	0 (± 0)	0 (± 0)	0.05 (± 0.03)	2.99 (± 0.37)
Cumulative impacts - Centralised mgmt.	1.72 (± 0.04)	5.19 (± 2.56)	2.07 (± 0.28)	0 (± 0)	0 (± 0)	0.09 (± 0.02)	3.96 (± 1.21)
Cumulative impacts - FewMPA	1.65 (± 0.11)	5.75 (± 6.13)	1.77 (± 0.52)	0 (± 0)	0 (± 0)	0.02 (± 0.01)	2.19 (± 0.61)
Cumulative impacts - Fragmented mgmt	1.73 (± 0.03)	5.37 (± 2.81)	2.1 (± 0.35)	0 (± 0)	0 (± 0)	0.03 (± 0.01)	3.64 (± 1.26)
Cumulative impacts - ManyMPA	1.72 (± 0.03)	2.21 (± 0.93)	1.17 (± 0.15)	0 (± 0)	0 (± 0)	0.1 (± 0.03)	1.07 (± 0.33)
Cumulative impacts - Seasons	1.72 (± 0.03)	2.33 (± 1.41)	1.18 (± 0.14)	0 (± 0)	0 (± 0)	0.1 (± 0.03)	1.3 (± 0.2)
Cumulative impacts - SlowAssess	1.74 (± 0.06)	4.57 (± 0.61)	1.99 (± 0.1)	0 (± 0)	0 (± 0)	0.04 (± 0.03)	3.84 (± 1.28)
Cumulative impacts - IM	1.19 (± 0.62)	7.26 (± 5.32)	0.77 (± 0.1)	0 (± 0)	0 (± 0)	0.21 (± 0.19)	0.81 (± 0.54)
Expanded LTL fishery - IM	1.74 (± 0.01)	3.04 (± 0.13)	2.14 (± 0.04)	0.11 (± 0.06)	0.29 (± 0.14)	0.51 (± 0.08)	4.8 (± 1.91)
New mesopelgic fishery - IM	1.75 (± 0.01)	3.22 (± 0.24)	2.17 (± 0.07)	0.25 (± 0.28)	0.3 (± 0.13)	0.11 (± 0.1)	5.13 (± 1.48)
Extreme climate events - IM	1.73 (± 0.01)	2.96 (± 0.19)	2.23 (± 0.11)	0.02 (± 0.02)	0.07 (± 0.02)	0.46 (± 0.32)	4.26 (± 1.21)

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
Blooms - IM	1.73 (± 0)	3 (± 0.2)	2.24 (± 0.1)	0.01 (± 0)	0.07 (± 0.04)	1.01 (± 0.16)	4.38 (± 1.63)
Primary production regime shift - IM	1.74 (± 0.03)	2.87 (± 0.25)	2.2 (± 0.09)	0.21 (± 0.33)	0.33 (± 0.48)	0.51 (± 0.16)	4.6 (± 1.33)
Fish kills - IM	1.73 (± 0.01)	2.84 (± 0.24)	2.22 (± 0.09)	0.01 (± 0.01)	0.07 (± 0.05)	0.38 (± 0.21)	4.06 (± 1.11)
Range extensions - IM	1.72 (± 0.02)	2.67 (± 0.37)	2.22 (± 0.08)	0.01 (± 0.01)	0.11 (± 0.03)	0.56 (± 0.06)	4.62 (± 1.39)
Gear switching allowed - IM	1.72 (± 0.01)	1.42 (± 0.07)	1.24 (± 0.04)	1.36 (± 0.11)	1.46 (± 0.22)	1.15 (± 0.06)	1.89 (± 0.11)
High compliance - IM	1.73 (± 0.01)	3.1 (± 0.26)	2.17 (± 0.08)	0.06 (± 0.05)	0.16 (± 0.17)	0.97 (± 0.14)	4.14 (± 0.93)
Low Compliance - IM	1.75 (± 0.01)	4.01 (± 0.76)	2.31 (± 0.09)	0 (± 0)	0.04 (± 0.04)	0.91 (± 0.15)	5.2 (± 2.56)
Flexible fisher behaviour - IM	1.67 (± 0.01)	2.87 (± 0.2)	1.99 (± 0.06)	0.07 (± 0.03)	0.21 (± 0.08)	0.29 (± 0.4)	4.8 (± 1.47)
Increased fishing pressure drivers - IM	1.73 (± 0.01)	2.85 (± 0.21)	2.21 (± 0.08)	0.02 (± 0.02)	0.06 (± 0.02)	0.87 (± 0.17)	4.01 (± 1.09)
High Cost, Low Values - IM	1.73 (± 0)	1.42 (± 0.08)	1.24 (± 0.01)	1.36 (± 0.06)	1.88 (± 0.02)	1.19 (± 0)	1.37 (± 0.43)
Low Costs, High Values - IM	1.26 (± 0.82)	2.3 (± 1.39)	2.42 (± 0.32)	0.04 (± 0.03)	0.14 (± 0.12)	0.16 (± 0.02)	3.3 (± 1.96)
Standard Markets - IM	1.73 (± 0.01)	2.85 (± 0.21)	2.21 (± 0.08)	0.02 (± 0.02)	0.06 (± 0.02)	0.9 (± 0.12)	4.01 (± 1.09)
Technology Creep - IM	1.7 (± 0.01)	2.51 (± 0.69)	1.78 (± 0.17)	0.78 (± 0.32)	1.07 (± 0.33)	0.21 (± 0.16)	4.72 (± 1.69)
No Acclimation - 2010 coastal context - IM	0.77 (± 0.51)	1.55 (± 1.15)	0.99 (± 0.67)	0.01 (± 0.01)	0.04 (± 0.04)	0.49 (± 0.42)	2.17 (± 1.61)
No Acclimation - Cumulative impacts - SQ	1.06 (± 0.62)	1.52 (± 0.88)	2.75 (± 1.88)	0 (± 0)	0 (± 0)	0.15 (± 0.12)	11.24 (± 8.34)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	1.06 (± 0.59)	2.65 (± 2.04)	1.58 (± 1.02)	4.81 (± 6.1)	1.68 (± 0.26)	2.04 (± 2.54)	1.03 (± 0.5)	2.1 (± 2.52)
2010 coastal context - Cap ecosystem take	0.87 (± 0.23)	4.63 (± 1.22)	0.17 (± 0.08)	0.72 (± 0.19)	1.09 (± 0.23)	0.57 (± 0.19)	0.96 (± 0.49)	0.48 (± 0.27)
2010 coastal context - Centralised mgmt.	1.01 (± 0.01)	5.63 (± 2.86)	0.16 (± 0.11)	0.8 (± 0.15)	1.25 (± 0.06)	0.67 (± 0.07)	1.29 (± 0.82)	1.02 (± 0.45)
2010 coastal context - FewMPA	0.94 (± 0.13)	4.88 (± 1.33)	0.02 (± 0.02)	0.14 (± 0.09)	1.36 (± 0.05)	0.19 (± 0)	0.64 (± 0.13)	0.27 (± 0.1)
2010 coastal context - Fragmented mgmt	0.99 (± 0.02)	5.5 (± 3.44)	0.1 (± 0.09)	0.75 (± 0.11)	1.25 (± 0.07)	0.64 (± 0.04)	1.19 (± 0.88)	0.39 (± 0.3)
2010 coastal context - ManyMPA	1.03 (± 0.02)	2.92 (± 2.61)	1.06 (± 0.05)	1 (± 0.07)	1.07 (± 0.04)	0.81 (± 0.06)	0.43 (± 0.67)	1.95 (± 0.29)
2010 coastal context - Seasons	1.01 (± 0.01)	3.58 (± 3.26)	1.06 (± 0.02)	0.99 (± 0.04)	1.09 (± 0.03)	0.83 (± 0.03)	0.58 (± 0.37)	1.68 (± 0.72)
2010 coastal context - SlowAssess	1.01 (± 0.02)	5.06 (± 2.4)	0.39 (± 0.54)	0.77 (± 0.24)	1.25 (± 0.08)	0.69 (± 0.14)	1.45 (± 0.85)	0.95 (± 0.81)
2010 coastal context - Integrated Mgmt (IM)	0.77 (± 0.52)	1.26 (± 0.58)	1.79 (± 0.88)	0.84 (± 0.75)	1.64 (± 0.53)	0.68 (± 0.23)	1.51 (± 1.87)	1.54 (± 1.31)
Cumulative impacts - 2010 Status Quo (SQ)	0.95 (± 0.12)	6.01 (± 3.1)	0.19 (± 0.16)	0 (± 0)	1.34 (± 0.06)	0.22 (± 0.01)	0.73 (± 0.88)	0.35 (± 0.09)
Cumulative impacts - Cap ecosystem take	0.82 (± 0.22)	4.32 (± 1.14)	1.33 (± 1.66)	0 (± 0)	1.17 (± 0.26)	0.2 (± 0.05)	0.91 (± 1.04)	0.28 (± 0.14)
Cumulative impacts - Centralised mgmt.	0.95 (± 0.1)	4.77 (± 0.55)	0.56 (± 0.46)	0 (± 0)	1.35 (± 0.04)	0.23 (± 0.01)	1.03 (± 1.24)	0.54 (± 0.24)
Cumulative impacts - FewMPA	0.89 (± 0.2)	4.85 (± 2.63)	0.3 (± 0.5)	0 (± 0)	1.46 (± 0.04)	0.07 (± 0.01)	0.64 (± 0.56)	0.34 (± 0.22)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
Cumulative impacts - Fragmented mgmt	0.94 (± 0.11)	4.46 (± 1.02)	0.46 (± 0.37)	0 (± 0)	1.34 (± 0.05)	0.22 (± 0.02)	0.9 (± 1.24)	0.41 (± 0.26)
Cumulative impacts - ManyMPA	0.97 (± 0.1)	2.45 (± 1.5)	4.63 (± 6.93)	0 (± 0)	1.15 (± 0.05)	0.28 (± 0.01)	0.06 (± 0.01)	1.11 (± 0.95)
Cumulative impacts - Seasons	0.95 (± 0.1)	2.99 (± 1.88)	4.83 (± 7.32)	0 (± 0)	1.17 (± 0.03)	0.29 (± 0.02)	0.5 (± 0.65)	0.66 (± 0.43)
Cumulative impacts - SlowAssess	0.96 (± 0.11)	4.35 (± 0.26)	0.35 (± 0.45)	0 (± 0)	1.34 (± 0.07)	0.24 (± 0.02)	1.17 (± 1.33)	0.39 (± 0.13)
Cumulative impacts - IM	0.75 (± 0.56)	1.38 (± 0.47)	11.64 (± 18.76)	0 (± 0)	1.76 (± 0.59)	0.24 (± 0.1)	0.5 (± 0.33)	1.42 (± 1.37)
Expanded LTL fishery - IM	1 (± 0.01)	3.54 (± 1.26)	0.52 (± 0.27)	0.87 (± 0.1)	1.26 (± 0.07)	0.7 (± 0.06)	1.25 (± 0.78)	1.03 (± 0.15)
New mesopelgic fishery - IM	1 (± 0)	3.31 (± 1.63)	0.47 (± 0.41)	0.99 (± 0.29)	1.26 (± 0.07)	0.72 (± 0.09)	1.2 (± 0.86)	0.92 (± 0.17)
Extreme climate events - IM	1.01 (± 0)	4.31 (± 1.72)	0.06 (± 0.06)	0.7 (± 0.17)	1.25 (± 0.07)	0.63 (± 0.08)	1.12 (± 0.82)	0.56 (± 0.13)
Blooms - IM	1.01 (± 0.02)	4.22 (± 1.78)	0.05 (± 0.02)	0.69 (± 0.08)	1.25 (± 0.06)	0.62 (± 0.04)	1.08 (± 0.83)	0.52 (± 0.38)
Primary production regime shift - IM	0.99 (± 0.01)	4.39 (± 1.89)	0.34 (± 0.48)	0.77 (± 0.18)	1.25 (± 0.08)	0.66 (± 0.08)	1.32 (± 0.94)	0.69 (± 0.55)
Fish kills - IM	1.02 (± 0.02)	4.46 (± 2.01)	0.06 (± 0.04)	0.69 (± 0.17)	1.25 (± 0.07)	0.63 (± 0.07)	1.14 (± 0.86)	0.49 (± 0.27)
Range extensions - IM	0.98 (± 0.02)	5.1 (± 0.48)	0.17 (± 0.2)	0.69 (± 0.01)	1.27 (± 0.05)	0.58 (± 0.05)	1.32 (± 0.44)	0.53 (± 0.25)
Gear switching allowed - IM	1.01 (± 0.02)	3.83 (± 0.55)	1.02 (± 0.03)	0.96 (± 0.05)	1.11 (± 0.02)	0.79 (± 0.06)	1.58 (± 0.68)	1.67 (± 0.48)
High compliance - IM	1 (± 0.02)	3.98 (± 2.12)	0.31 (± 0.34)	0.74 (± 0.28)	1.26 (± 0.08)	0.65 (± 0.12)	1.23 (± 0.9)	0.92 (± 0.69)
Low Compliance - IM	1.01 (± 0)	3.77 (± 2.12)	0.15 (± 0.26)	0.53 (± 0.05)	1.27 (± 0.08)	0.58 (± 0)	0.88 (± 0.67)	0.37 (± 0.13)
Flexible fisher behaviour - IM	1.01 (± 0.03)	4.32 (± 1.59)	0.19 (± 0.06)	0.84 (± 0.1)	1.03 (± 0.05)	0.69 (± 0.06)	1.14 (± 0.74)	1.11 (± 0.66)
Increased fishing pressure drivers - IM	1.01 (± 0.03)	4.43 (± 1.97)	0.31 (± 0.4)	0.68 (± 0.2)	1.25 (± 0.07)	0.63 (± 0.08)	1.1 (± 0.86)	0.58 (± 0.24)
High Cost, Low Values - IM	1.02 (± 0.02)	1.64 (± 1.49)	1.09 (± 0.01)	1.04 (± 0)	1.06 (± 0.05)	0.84 (± 0.03)	0.21 (± 0.1)	1.07 (± 0.89)
Low Costs, High Values - IM	0.73 (± 0.47)	3.29 (± 2.31)	0.28 (± 0.18)	0.75 (± 0.21)	0.93 (± 0.52)	0.52 (± 0.32)	0.81 (± 0.64)	0.37 (± 0.32)
Standard Markets - IM	1.01 (± 0.03)	4.43 (± 1.97)	0.06 (± 0.07)	0.68 (± 0.2)	1.25 (± 0.07)	0.63 (± 0.08)	1.1 (± 0.86)	0.67 (± 0.29)
Technology Creep - IM	1.01 (± 0.02)	2.98 (± 1.26)	0.97 (± 0.14)	0.98 (± 0.07)	1.09 (± 0.05)	0.77 (± 0.07)	1.3 (± 0.79)	0.94 (± 0.8)
No Acclimation - 2010 coastal context - IM	0.44 (± 0.29)	2.75 (± 2.68)	0.04 (± 0.06)	0.33 (± 0.26)	0.54 (± 0.35)	0.35 (± 0.26)	0.55 (± 0.52)	0.18 (± 0.05)
No Acclimation - Cumulative impacts - SQ	0.71 (± 0.65)	14.61 (± 15.73)	0.01 (± 0.02)	5.33 (± 9.05)	0.4 (± 0.23)	0.25 (± 0.24)	0.94 (± 1.31)	0.07 (± 0.08)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	2.83 (± 0.96)	3.07 (± 1.63)	2.44 (± 2.08)	2.86 (± 2.78)	2.7 (± 3.16)	0.81 (± 0.65)	3.57 (± 2.2)	1.3 (± 0.21)
2010 coastal context - Cap ecosystem take	2.52 (± 1.8)	1.04 (± 0.29)	0.47 (± 0.11)	2.57 (± 0.92)	1.31 (± 0.78)	0.69 (± 0.23)	3.35 (± 0.8)	1.2 (± 0.03)
2010 coastal context - Centralised mgmt.	2.83 (± 2.62)	1.21 (± 0.05)	0.58 (± 0.18)	2.84 (± 1.35)	1.58 (± 0.9)	0.99 (± 0.51)	3.16 (± 1.19)	1.22 (± 0.04)
2010 coastal context - FewMPA	5.2 (± 2.23)	1.12 (± 0.03)	0.25 (± 0.13)	2.22 (± 0.99)	1.45 (± 0.77)	0.76 (± 0.17)	1.01 (± 0.66)	0.88 (± 0.01)
2010 coastal context - Fragmented mgmt	2.38 (± 1.6)	1.19 (± 0.07)	0.39 (± 0.24)	2.25 (± 1.35)	1.57 (± 0.9)	0.88 (± 0.63)	4.02 (± 1.18)	1.17 (± 0.03)
2010 coastal context - ManyMPA	1.34 (± 1.04)	1.21 (± 0.16)	0.44 (± 0.02)	1.33 (± 1.04)	1.46 (± 0.8)	0.39 (± 0.51)	1.57 (± 2.59)	0.95 (± 0.08)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
2010 coastal context - Seasons	2.02 (± 1.32)	1.34 (± 0.11)	0.33 (± 0.1)	2.6 (± 1.76)	1.72 (± 1.03)	0.26 (± 0.01)	0.46 (± 0.51)	0.94 (± 0.01)
2010 coastal context - SlowAssess	1.17 (± 0.5)	1.23 (± 0.04)	0.4 (± 0.07)	3.27 (± 1.62)	1.64 (± 0.93)	1.32 (± 0.25)	3.45 (± 2.78)	1.22 (± 0.06)
2010 coastal context - Integrated Mgmt (IM)	1.58 (± 1.13)	2.42 (± 1.25)	0.57 (± 0.15)	1.21 (± 0.47)	2.2 (± 2.4)	0.67 (± 0.29)	0.88 (± 0.52)	1.22 (± 0.35)
Cumulative impacts - 2010 Status Quo (SQ)	4.06 (± 3.21)	1.17 (± 0.04)	0.33 (± 0.16)	2.79 (± 1.54)	1.61 (± 0.91)	1.43 (± 0.29)	0.94 (± 0.54)	1.03 (± 0.02)
Cumulative impacts - Cap ecosystem take	2.76 (± 2.26)	1.04 (± 0.27)	0.3 (± 0.2)	2.27 (± 0.56)	1.34 (± 0.82)	1.58 (± 0.76)	0.8 (± 0.58)	1.01 (± 0.06)
Cumulative impacts - Centralised mgmt.	3.24 (± 3.44)	1.21 (± 0.02)	0.36 (± 0.19)	2.54 (± 1.2)	1.62 (± 0.92)	2.08 (± 0.71)	0.73 (± 0.5)	1.02 (± 0.07)
Cumulative impacts - FewMPA	5.91 (± 3.36)	1.12 (± 0.04)	0.23 (± 0.28)	1.99 (± 0.89)	1.49 (± 0.79)	1.89 (± 1.02)	0.27 (± 0.36)	0.74 (± 0.03)
Cumulative impacts - Fragmented mgmt	2.6 (± 1.98)	1.19 (± 0.07)	0.35 (± 0.21)	2.02 (± 1.25)	1.61 (± 0.92)	1.76 (± 0.96)	1.17 (± 1.22)	0.98 (± 0.04)
Cumulative impacts - ManyMPA	1.32 (± 0.77)	1.21 (± 0.18)	0.37 (± 0.19)	1.19 (± 0.97)	1.5 (± 0.82)	0.56 (± 0.46)	0.22 (± 0.33)	0.79 (± 0.04)
Cumulative impacts - Seasons	2.13 (± 1.41)	1.34 (± 0.12)	0.29 (± 0.12)	2.36 (± 1.65)	1.76 (± 1.05)	0.64 (± 0.31)	0.03 (± 0.02)	0.78 (± 0.03)
Cumulative impacts - SlowAssess	1.29 (± 0.71)	1.23 (± 0.02)	0.3 (± 0.19)	2.91 (± 1.41)	1.68 (± 0.95)	3.06 (± 1.14)	0.5 (± 0.21)	1.02 (± 0.05)
Cumulative impacts - IM	1.8 (± 1.34)	2.4 (± 1.19)	0.3 (± 0.24)	1.13 (± 0.5)	2.23 (± 2.4)	1.44 (± 0.41)	0.19 (± 0.16)	1.02 (± 0.26)
Expanded LTL fishery - IM	1.33 (± 0.79)	1.21 (± 0.04)	0.46 (± 0.03)	2.38 (± 1.23)	1.64 (± 0.93)	1.11 (± 0.38)	2.62 (± 1.5)	1.22 (± 0.04)
New mesopelgic fishery - IM	1.18 (± 1.02)	1.19 (± 0.05)	0.49 (± 0.08)	2.3 (± 1.35)	1.64 (± 0.94)	0.98 (± 0.56)	2.79 (± 1.34)	1.18 (± 0.07)
Extreme climate events - IM	3.02 (± 2.18)	1.18 (± 0.04)	0.61 (± 0.12)	1.84 (± 1.49)	1.57 (± 0.9)	0.9 (± 0.66)	4.41 (± 1.13)	1.22 (± 0.02)
Blooms - IM	2.94 (± 2.07)	1.18 (± 0.07)	0.65 (± 0.08)	1.94 (± 1.82)	1.57 (± 0.9)	0.8 (± 0.7)	4.43 (± 0.67)	1.23 (± 0.05)
Primary production regime shift - IM	2.99 (± 2.24)	1.2 (± 0.11)	0.6 (± 0.21)	2.97 (± 1.67)	1.58 (± 0.9)	1.05 (± 0.62)	3.09 (± 2.09)	1.21 (± 0.03)
Fish kills - IM	3.83 (± 2.83)	1.17 (± 0.07)	0.61 (± 0.13)	3.18 (± 1.84)	1.57 (± 0.9)	0.81 (± 0.65)	4.29 (± 1.27)	1.23 (± 0.04)
Range extensions - IM	3.47 (± 1.16)	1.16 (± 0.09)	0.62 (± 0.05)	3.08 (± 0.25)	2.01 (± 0.17)	0.85 (± 0.64)	5.22 (± 1.33)	1.47 (± 0.39)
Gear switching allowed - IM	1.24 (± 1.02)	1.34 (± 0.02)	0.35 (± 0.06)	2.81 (± 1.02)	1.71 (± 0.99)	1.36 (± 0.08)	0.9 (± 0.79)	1.07 (± 0.03)
High compliance - IM	2.46 (± 1.43)	1.2 (± 0.04)	0.59 (± 0.13)	2.65 (± 1.71)	1.59 (± 0.9)	1 (± 0.59)	3.73 (± 2.2)	1.2 (± 0.01)
Low Compliance - IM	1.07 (± 0.83)	1.15 (± 0.06)	0.49 (± 0.1)	1.49 (± 0.84)	1.61 (± 0.91)	0.56 (± 0.37)	4.98 (± 0.29)	1.21 (± 0.04)
Flexible fisher behaviour - IM	3.08 (± 2.16)	1.22 (± 0.05)	0.51 (± 0.22)	3.03 (± 1.34)	1.59 (± 0.9)	0.88 (± 0.53)	2.64 (± 0.79)	1.21 (± 0.01)
Increased fishing pressure drivers - IM	3.79 (± 2.79)	1.17 (± 0.06)	0.48 (± 0.11)	3.17 (± 1.8)	1.57 (± 0.9)	0.79 (± 0.66)	4.27 (± 1.48)	1.23 (± 0.03)
High Cost, Low Values - IM	0.62 (± 0.03)	1.24 (± 0.14)	0.15 (± 0.17)	1.53 (± 0.62)	1.7 (± 0.96)	0.23 (± 0.03)	0.13 (± 0.15)	0.93 (± 0.03)
Low Costs, High Values - IM	1.25 (± 1.16)	0.92 (± 0.55)	0.32 (± 0.25)	1.96 (± 1.19)	1.04 (± 0.92)	0.59 (± 0.41)	2.42 (± 0.17)	1.17 (± 0.08)
Standard Markets - IM	3.79 (± 2.79)	1.17 (± 0.06)	0.58 (± 0.11)	3.17 (± 1.8)	1.57 (± 0.9)	0.79 (± 0.66)	4.27 (± 1.48)	1.23 (± 0.03)
Technology Creep - IM	1.74 (± 0.81)	1.25 (± 0.04)	0.36 (± 0.04)	1.19 (± 1)	1.44 (± 0.8)	1.12 (± 0.1)	0.61 (± 0.14)	1.13 (± 0.03)
No Acclimation - 2010 coastal context - IM	2.32 (± 3.08)	0.67 (± 0.56)	0.39 (± 0.26)	1.83 (± 1.87)	0.92 (± 1.09)	0.29 (± 0.11)	1.01 (± 0.67)	0.45 (± 0.62)
No Acclimation - Cumulative impacts - SQ	10.5 (± 12.18)	0.29 (± 0.13)	0.72 (± 0.49)	8.02 (± 11.56)	1.28 (± 1.63)	0.4 (± 0.03)	4.73 (± 2.65)	0.43 (± 0.59)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
No Climate change - 2010 context - SQ	1.11 (± 1.45)	1.42 (± 0.31)	3.72 (± 2.48)	0.87 (± 0.37)	3.62 (± 3.39)	1.83 (± 0.8)	0.99 (± 0.43)	0.74 (± 0.26)
2010 coastal context - Cap ecosystem take	11.62 (± 3.62)	1.07 (± 0.04)	0.61 (± 0.22)	4.63 (± 0.44)	1.11 (± 0.12)	1.3 (± 0.26)	1.43 (± 0.39)	0.28 (± 0.01)
2010 coastal context - Centralised mgmt.	12.93 (± 5.06)	1.1 (± 0.01)	0.51 (± 0.17)	4.82 (± 0.52)	1.29 (± 0.15)	1.53 (± 0.17)	1.2 (± 0.01)	0.29 (± 0)
2010 coastal context - FewMPA	9.02 (± 0.81)	1.07 (± 0)	0.85 (± 0.1)	0.04 (± 0.02)	1.05 (± 0.15)	1.56 (± 0.15)	0.78 (± 0.04)	0.27 (± 0)
2010 coastal context - Fragmented mgmt	11.94 (± 5.94)	1.1 (± 0.01)	0.66 (± 0.06)	4.42 (± 0.35)	1.21 (± 0.15)	1.53 (± 0.15)	1.2 (± 0.01)	0.29 (± 0.01)
2010 coastal context - ManyMPA	5.14 (± 8.3)	1.12 (± 0)	0.7 (± 0.39)	4.74 (± 0.08)	1.09 (± 0.05)	0.82 (± 0.07)	1.22 (± 0)	0.25 (± 0.01)
2010 coastal context - Seasons	3.08 (± 0.71)	1.13 (± 0)	0.35 (± 0.12)	5.36 (± 0.77)	1.03 (± 0.14)	0.81 (± 0.05)	1.22 (± 0)	0.23 (± 0)
2010 coastal context - SlowAssess	13.36 (± 2.87)	1.11 (± 0.02)	0.58 (± 0.36)	6.59 (± 3.56)	1.1 (± 0.27)	1.49 (± 0.26)	1.22 (± 0.05)	0.3 (± 0.01)
2010 coastal context - Integrated Mgmt (IM)	11.97 (± 3.6)	1.17 (± 0.23)	0.61 (± 0.33)	4.72 (± 4.36)	4.03 (± 3.08)	1.67 (± 0.71)	1.11 (± 0.17)	1.08 (± 0.95)
Cumulative impacts - 2010 Status Quo (SQ)	9.69 (± 4.96)	1.1 (± 0)	0.55 (± 0.3)	2.16 (± 0.34)	1.02 (± 0.22)	1.67 (± 0.18)	0.82 (± 0.03)	0.26 (± 0.01)
Cumulative impacts - Cap ecosystem take	9.48 (± 2.97)	1.08 (± 0.04)	0.65 (± 0.13)	2.21 (± 0.29)	0.98 (± 0.27)	1.42 (± 0.27)	0.99 (± 0.28)	0.26 (± 0)
Cumulative impacts - Centralised mgmt.	10.55 (± 4.1)	1.11 (± 0)	0.67 (± 0.15)	2.29 (± 0.14)	1.14 (± 0.3)	1.67 (± 0.21)	0.83 (± 0.03)	0.27 (± 0.01)
Cumulative impacts - FewMPA	7.34 (± 0.7)	1.08 (± 0.01)	0.28 (± 0.13)	0.02 (± 0.01)	0.92 (± 0.19)	1.71 (± 0.19)	0.54 (± 0.05)	0.25 (± 0)
Cumulative impacts - Fragmented mgmt	9.76 (± 4.82)	1.1 (± 0)	0.55 (± 0.2)	2.11 (± 0.24)	1.08 (± 0.33)	1.68 (± 0.19)	0.82 (± 0.02)	0.26 (± 0.01)
Cumulative impacts - ManyMPA	4.06 (± 6.54)	1.13 (± 0.01)	0.67 (± 0.04)	2.26 (± 0.18)	0.97 (± 0.26)	0.9 (± 0.07)	0.84 (± 0.03)	0.23 (± 0.01)
Cumulative impacts - Seasons	2.52 (± 0.63)	1.13 (± 0)	0.6 (± 0.16)	2.57 (± 0.52)	0.92 (± 0.27)	0.89 (± 0.05)	0.84 (± 0.03)	0.21 (± 0)
Cumulative impacts - SlowAssess	10.86 (± 2.26)	1.12 (± 0.02)	0.59 (± 0.11)	3.21 (± 1.96)	1.01 (± 0.45)	1.64 (± 0.31)	0.84 (± 0.06)	0.27 (± 0)
Cumulative impacts - IM	1.64 (± 1.04)	1.18 (± 0.23)	0.79 (± 0.11)	1.82 (± 2.01)	3.87 (± 3.55)	1.7 (± 0.98)	0.76 (± 0.1)	1 (± 0.88)
Expanded LTL fishery - IM	12.64 (± 4.13)	1.11 (± 0.01)	0.51 (± 0.19)	5.18 (± 0.79)	0.92 (± 0.12)	1.56 (± 0.17)	1.22 (± 0.01)	0.29 (± 0)
New mesopelgic fishery - IM	11.88 (± 5.38)	1.11 (± 0.01)	0.53 (± 0.35)	5.16 (± 0.78)	0.93 (± 0.13)	1.58 (± 0.16)	1.22 (± 0.01)	0.29 (± 0)
Extreme climate events - IM	12.35 (± 6.58)	1.09 (± 0)	0.69 (± 0.28)	4.76 (± 0.74)	1.07 (± 0.19)	1.53 (± 0.11)	1.19 (± 0.01)	0.29 (± 0.01)
Blooms - IM	11.75 (± 6.95)	1.09 (± 0)	0.72 (± 0.17)	4.62 (± 0.21)	0.98 (± 0.29)	1.54 (± 0.14)	1.19 (± 0)	0.28 (± 0.01)
Primary production regime shift - IM	13.43 (± 6.54)	1.11 (± 0.02)	0.71 (± 0.28)	6.82 (± 4.19)	0.91 (± 0.18)	1.51 (± 0.16)	1.22 (± 0.05)	0.29 (± 0.01)
Fish kills - IM	12.16 (± 6.38)	1.09 (± 0)	0.59 (± 0.23)	4.39 (± 0.53)	1.16 (± 0.08)	1.52 (± 0.15)	1.19 (± 0.01)	0.28 (± 0.01)
Range extensions - IM	14.9 (± 3.87)	1.33 (± 0.41)	0.73 (± 0.22)	5.85 (± 1.92)	1.32 (± 0.28)	1.43 (± 0.24)	1.15 (± 0.08)	0.35 (± 0.1)
Gear switching allowed - IM	13.63 (± 2.66)	1.13 (± 0)	0.44 (± 0.42)	4.72 (± 0.53)	0.99 (± 0.06)	0.86 (± 0)	1.22 (± 0)	0.29 (± 0)
High compliance - IM	13.01 (± 5.06)	1.1 (± 0.01)	0.74 (± 0.33)	5.02 (± 0.89)	1.28 (± 0.32)	1.54 (± 0.15)	1.19 (± 0.02)	0.29 (± 0)
Low Compliance - IM	9.09 (± 3.63)	1.09 (± 0)	0.72 (± 0.19)	4.23 (± 0.34)	0.96 (± 0.05)	1.6 (± 0.2)	1.18 (± 0.01)	0.29 (± 0.01)
Flexible fisher behaviour - IM	12.65 (± 5.59)	1.1 (± 0)	0.37 (± 0.05)	4.71 (± 0.24)	1.11 (± 0.17)	1.28 (± 0.11)	1.19 (± 0.01)	0.29 (± 0.01)
Increased fishing pressure drivers - IM	11.95 (± 6.38)	1.09 (± 0)	0.69 (± 0.29)	4.51 (± 0.54)	1.16 (± 0.07)	1.52 (± 0.14)	1.19 (± 0.01)	0.28 (± 0.01)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Seabirds	Spotted Warehou	Seals	Gulper shark
High Cost, Low Values - IM	1.25 (± 0.52)	1.13 (± 0)	0.21 (± 0.01)	4.02 (± 0.85)	1 (± 0.21)	0.85 (± 0.02)	1.22 (± 0)	0.23 (± 0)
Low Costs, High Values - IM	11.3 (± 1.92)	1.06 (± 0.08)	0.33 (± 0.03)	4.76 (± 0.34)	1.05 (± 0.31)	1.08 (± 0.65)	1.67 (± 0.8)	0.28 (± 0.02)
Standard Markets - IM	11.95 (± 6.38)	1.09 (± 0)	0.76 (± 0.39)	4.51 (± 0.54)	1.16 (± 0.07)	1.52 (± 0.14)	1.19 (± 0.01)	0.28 (± 0.01)
Technology Creep - IM	12.58 (± 4.81)	1.12 (± 0)	0.51 (± 0.32)	4.21 (± 0.45)	1.23 (± 0.28)	1.26 (± 0.13)	1.22 (± 0.01)	0.29 (± 0)
No Acclimation - 2010 coastal context - IM	3.35 (± 4)	0.41 (± 0.58)	0.15 (± 0.12)	1.83 (± 2.63)	1.74 (± 0.61)	0.8 (± 0.59)	0.2 (± 0.09)	0.03 (± 0.01)
No Acclimation - Cumulative impacts - SQ	22.06 (± 25.6)	0.41 (± 0.57)	0.12 (± 0.09)	4.64 (± 7.37)	0.63 (± 0.4)	0.8 (± 0.23)	0.21 (± 0.14)	0.01 (± 0.01)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
No Climate change - 2010 context - SQ	1.47 (± 1.5)	1.44 (± 0.27)	1.53 (± 0.3)	1.66 (± 0.89)	1.52 (± 0.6)	0.65 (± 0.09)	1.13 (± 0.05)	0.14 (± 0.1)
2010 coastal context - Cap ecosystem take	9.84 (± 1.94)	1.67 (± 0.46)	1.32 (± 0.35)	1.31 (± 0.36)	3500.72 (± 6062.86)	0.33 (± 0.15)	0.53 (± 0.01)	0.16 (± 0.07)
2010 coastal context - Centralised mgmt.	7.33 (± 1.89)	1.4 (± 0)	1.13 (± 0.05)	1.1 (± 0)	0.35 (± 0.14)	0.25 (± 0.01)	0.53 (± 0.01)	0.12 (± 0)
2010 coastal context - FewMPA	7.38 (± 0.95)	1.44 (± 0.01)	0.53 (± 0.01)	1.01 (± 0.06)	176.29 (± 305.34)	0.19 (± 0.02)	0.35 (± 0)	0.12 (± 0)
2010 coastal context - Fragmented mgmt	7.98 (± 0.46)	1.41 (± 0)	1.1 (± 0.05)	1.1 (± 0)	0.27 (± 0.15)	0.25 (± 0.02)	0.53 (± 0.01)	0.12 (± 0)
2010 coastal context - ManyMPA	7.47 (± 1.4)	1.4 (± 0)	1.3 (± 0.01)	1.11 (± 0.01)	2.35 (± 0.02)	0.25 (± 0.01)	0.55 (± 0)	0.12 (± 0)
2010 coastal context - Seasons	7.08 (± 0.78)	1.41 (± 0)	1.3 (± 0.01)	1.11 (± 0.01)	2.35 (± 0.02)	0.25 (± 0.01)	0.55 (± 0)	0.12 (± 0)
2010 coastal context - SlowAssess	8.26 (± 1.54)	1.41 (± 0.02)	1.17 (± 0.18)	1.13 (± 0.06)	0.94 (± 1.27)	0.28 (± 0.03)	0.59 (± 0.13)	0.12 (± 0)
2010 coastal context - Integrated Mgmt (IM)	9.16 (± 0.91)	1.48 (± 0.1)	1.49 (± 0.3)	1.77 (± 0.93)	61.12 (± 103.22)	0.38 (± 0.06)	0.44 (± 0.13)	0.27 (± 0.12)
Cumulative impacts - 2010 Status Quo (SQ)	7.2 (± 1.11)	1.44 (± 0.01)	0.66 (± 0.02)	1.04 (± 0.04)	0 (± 0)	0.23 (± 0.02)	0.4 (± 0)	0.12 (± 0)
Cumulative impacts - Cap ecosystem take	9.83 (± 2.4)	1.71 (± 0.47)	0.83 (± 0.26)	1.25 (± 0.35)	5.75 (± 9.95)	0.3 (± 0.14)	0.54 (± 0.23)	0.16 (± 0.07)
Cumulative impacts - Centralised mgmt.	7.23 (± 1.6)	1.43 (± 0.01)	0.7 (± 0)	1.05 (± 0.03)	62.22 (± 107.77)	0.23 (± 0.02)	0.41 (± 0)	0.12 (± 0)
Cumulative impacts - FewMPA	7.3 (± 0.7)	1.46 (± 0.02)	0.33 (± 0.02)	0.96 (± 0.09)	0.02 (± 0.03)	0.18 (± 0.02)	0.27 (± 0)	0.12 (± 0)
Cumulative impacts - Fragmented mgmt	7.94 (± 0.8)	1.44 (± 0.01)	0.68 (± 0.03)	1.04 (± 0.03)	0.05 (± 0.09)	0.23 (± 0.02)	0.41 (± 0.01)	0.12 (± 0)
Cumulative impacts - ManyMPA	7.4 (± 1.26)	1.43 (± 0.01)	0.81 (± 0.03)	1.05 (± 0.03)	0.77 (± 1.34)	0.23 (± 0.01)	0.42 (± 0)	0.12 (± 0)
Cumulative impacts - Seasons	7.01 (± 0.49)	1.44 (± 0.01)	0.81 (± 0.03)	1.05 (± 0.03)	77.75 (± 134.67)	0.23 (± 0.01)	0.42 (± 0)	0.12 (± 0)
Cumulative impacts - SlowAssess	8.25 (± 1.93)	1.44 (± 0.03)	0.73 (± 0.08)	1.08 (± 0.09)	0 (± 0)	0.25 (± 0.03)	0.46 (± 0.09)	0.12 (± 0)
Cumulative impacts - IM	2.49 (± 1.23)	1.02 (± 0.55)	0.92 (± 0.15)	1.7 (± 0.94)	0.59 (± 1.03)	0.35 (± 0.06)	0.29 (± 0.04)	0.27 (± 0.12)
Expanded LTL fishery - IM	8.45 (± 1.3)	1.42 (± 0.01)	1.18 (± 0.05)	1.12 (± 0.01)	0.53 (± 0.17)	0.25 (± 0.01)	0.54 (± 0.01)	0.12 (± 0)
New mesopelgic fishery - IM	8.58 (± 1.51)	1.42 (± 0)	1.19 (± 0.07)	1.12 (± 0.01)	0.92 (± 0.77)	0.25 (± 0.01)	0.54 (± 0.01)	0.12 (± 0)
Extreme climate events - IM	6.9 (± 0.54)	1.41 (± 0)	1.07 (± 0.05)	1.1 (± 0)	0.19 (± 0.13)	0.25 (± 0.01)	0.52 (± 0.01)	0.12 (± 0)
Blooms - IM	7.57 (± 0.75)	1.41 (± 0)	1.07 (± 0.02)	1.1 (± 0)	0.18 (± 0.05)	0.25 (± 0.01)	0.52 (± 0)	0.12 (± 0)
Primary production regime shift - IM	6.3 (± 0.7)	1.42 (± 0.01)	1.16 (± 0.16)	1.13 (± 0.07)	0.81 (± 1.07)	0.8 (± 0.97)	0.59 (± 0.13)	0.12 (± 0)

Scenario	Baleen whales	Dolphins	Orca	Sealion	Squid	Scallops	Oysters	Deep filter feeders
Fish kills - IM	6.85 (± 1.14)	1.41 (± 0)	1.08 (± 0.06)	1.1 (± 0.01)	0.19 (± 0.12)	0.25 (± 0.01)	0.52 (± 0.01)	0.12 (± 0)
Range extensions - IM	6.71 (± 0.42)	1.35 (± 0.09)	1.03 (± 0.07)	1.05 (± 0.07)	0.29 (± 0.14)	0.26 (± 0)	0.53 (± 0.01)	0.12 (± 0)
Gear switching allowed - IM	6.9 (± 1.06)	1.41 (± 0)	1.29 (± 0.01)	1.11 (± 0)	2.33 (± 0.01)	0.25 (± 0.01)	0.55 (± 0)	0.12 (± 0)
High compliance - IM	8.45 (± 1.14)	1.4 (± 0)	1.1 (± 0.12)	1.1 (± 0.01)	0.32 (± 0.26)	0.25 (± 0.02)	0.53 (± 0.02)	0.12 (± 0)
Low Compliance - IM	7.29 (± 0.28)	1.41 (± 0)	1 (± 0.04)	1.1 (± 0)	0.05 (± 0.04)	0.24 (± 0.02)	0.51 (± 0.01)	0.12 (± 0)
Flexible fisher behaviour - IM	5.57 (± 0.35)	1.4 (± 0)	1.14 (± 0.03)	1.08 (± 0.01)	0.4 (± 0.07)	0.25 (± 0.01)	0.53 (± 0)	0.12 (± 0)
Increased fishing pressure drivers - IM	7.29 (± 1.4)	1.41 (± 0)	1.07 (± 0.06)	1.1 (± 0.01)	0.18 (± 0.16)	0.25 (± 0.01)	0.52 (± 0.01)	0.12 (± 0)
High Cost, Low Values - IM	7.93 (± 0.6)	1.41 (± 0)	1.31 (± 0)	1.11 (± 0.01)	2.37 (± 0.03)	0.25 (± 0.01)	0.55 (± 0)	0.12 (± 0)
Low Costs, High Values - IM	12.39 (± 5.28)	1.94 (± 0.93)	1.58 (± 0.75)	1.52 (± 0.73)	1167.25 (± 2021.04)	0.29 (± 0.08)	0.88 (± 0.59)	0.19 (± 0.13)
Standard Markets - IM	7.29 (± 1.4)	1.41 (± 0)	1.07 (± 0.06)	1.1 (± 0.01)	0.18 (± 0.16)	0.25 (± 0.01)	0.52 (± 0.01)	0.12 (± 0)
Technology Creep - IM	8.01 (± 0.13)	1.4 (± 0)	1.26 (± 0.03)	1.11 (± 0)	1.64 (± 0.4)	0.25 (± 0.01)	0.55 (± 0)	0.12 (± 0)
No Acclimation - 2010 coastal context - IM	1.18 (± 0.27)	0.24 (± 0.12)	0.18 (± 0.08)	0.18 (± 0.09)	70.54 (± 121.96)	0.12 (± 0.01)	0.25 (± 0.03)	0.06 (± 0.01)
No Acclimation - Cumulative impacts - SQ	4.27 (± 2.96)	0.38 (± 0.18)	0.12 (± 0.08)	0.13 (± 0.08)	0.03 (± 0.04)	0.08 (± 0.01)	0.32 (± 0.05)	0.03 (± 0.02)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
No Climate change - 2010 context - SQ	1.15 (± 0.27)	1.08 (± 0.19)	1.5 (± 0.28)	1.31 (± 0.35)	0.96 (± 0.03)	0.98 (± 0.19)	1.46 (± 0.31)	3.47 (± 0.17)
2010 coastal context - Cap ecosystem take	0.06 (± 0.03)	0.75 (± 0.21)	1.06 (± 0.3)	0.57 (± 0.16)	0.88 (± 0.21)	1.62 (± 0.46)	1.09 (± 0.13)	3.66 (± 0.86)
2010 coastal context - Centralised mgmt.	0.05 (± 0)	0.63 (± 0)	0.89 (± 0.01)	0.48 (± 0.01)	0.73 (± 0.09)	1.36 (± 0.01)	1.17 (± 0)	4.16 (± 0.01)
2010 coastal context - FewMPA	0.05 (± 0)	0.63 (± 0)	0.68 (± 0)	0.26 (± 0.01)	0.08 (± 0.01)	1.4 (± 0)	1.08 (± 0)	4.16 (± 0.01)
2010 coastal context - Fragmented mgmt	0.05 (± 0)	0.63 (± 0)	0.89 (± 0.01)	0.48 (± 0.02)	0.71 (± 0.09)	1.36 (± 0.01)	1.17 (± 0.01)	4.16 (± 0.01)
2010 coastal context - ManyMPA	0.05 (± 0)	0.63 (± 0)	0.93 (± 0.01)	0.51 (± 0.01)	1.09 (± 0.17)	1.34 (± 0)	1.18 (± 0)	4.17 (± 0.01)
2010 coastal context - Seasons	0.05 (± 0)	0.63 (± 0)	0.93 (± 0)	0.51 (± 0.01)	1.03 (± 0.07)	1.34 (± 0)	1.18 (± 0)	4.16 (± 0.01)
2010 coastal context - SlowAssess	0.06 (± 0.03)	0.63 (± 0)	0.93 (± 0.09)	1.11 (± 1.09)	0.77 (± 0.18)	1.3 (± 0.1)	1.22 (± 0.1)	3.42 (± 1.28)
2010 coastal context - Integrated Mgmt (IM)	0.42 (± 0.39)	1.56 (± 0.29)	1.05 (± 0.13)	0.87 (± 0.28)	0.97 (± 0.05)	0.87 (± 0.32)	1.41 (± 0.22)	2.96 (± 0.06)
Cumulative impacts - 2010 Status Quo (SQ)	0.04 (± 0)	0.63 (± 0)	0.67 (± 0)	0.31 (± 0.01)	0.04 (± 0.01)	1.41 (± 0)	1.07 (± 0)	4.16 (± 0.01)
Cumulative impacts - Cap ecosystem take	0.05 (± 0.02)	0.75 (± 0.21)	0.82 (± 0.24)	0.38 (± 0.12)	0.05 (± 0.01)	1.68 (± 0.47)	1.01 (± 0.12)	3.66 (± 0.86)
Cumulative impacts - Centralised mgmt.	0.04 (± 0)	0.63 (± 0)	0.68 (± 0.01)	0.32 (± 0.02)	0.04 (± 0.01)	1.41 (± 0)	1.08 (± 0)	4.16 (± 0.01)
Cumulative impacts - FewMPA	0.04 (± 0)	0.63 (± 0)	0.52 (± 0.01)	0.17 (± 0.01)	0 (± 0)	1.45 (± 0.01)	0.99 (± 0)	4.16 (± 0.01)
Cumulative impacts - Fragmented mgmt	0.04 (± 0)	0.63 (± 0)	0.68 (± 0.02)	0.31 (± 0.02)	0.04 (± 0.01)	1.41 (± 0.01)	1.08 (± 0.01)	4.16 (± 0.01)
Cumulative impacts - ManyMPA	0.04 (± 0)	0.63 (± 0)	0.72 (± 0.01)	0.34 (± 0.02)	0.06 (± 0.01)	1.39 (± 0.01)	1.09 (± 0)	4.17 (± 0.01)
Cumulative impacts - Seasons	0.04 (± 0)	0.63 (± 0)	0.71 (± 0.01)	0.34 (± 0.01)	0.06 (± 0.01)	1.39 (± 0.01)	1.09 (± 0)	4.16 (± 0.01)

Scenario	Urchins & Abalone	Deep crustaceans	Lobster	Shallow crustaceans	Prawns	Krill	Deposit feeders	Macroalgae
Cumulative impacts - SlowAssess	0.06 (± 0.03)	0.63 (± 0)	0.71 (± 0.06)	0.71 (± 0.66)	0.05 (± 0.01)	1.35 (± 0.1)	1.13 (± 0.09)	4.09 (± 0.13)
Cumulative impacts - IM	0.36 (± 0.33)	1.56 (± 0.29)	0.8 (± 0.09)	0.58 (± 0.2)	0.06 (± 0.01)	0.9 (± 0.33)	1.31 (± 0.21)	2.63 (± 0.54)
Expanded LTL fishery - IM	0.05 (± 0)	0.63 (± 0)	0.91 (± 0.01)	0.5 (± 0.01)	0.77 (± 0.08)	1.35 (± 0)	1.17 (± 0)	4.17 (± 0.01)
New mesopelgic fishery - IM	0.05 (± 0)	0.63 (± 0)	0.91 (± 0.02)	0.5 (± 0.01)	0.81 (± 0.14)	1.35 (± 0.01)	1.17 (± 0.01)	4.17 (± 0.01)
Extreme climate events - IM	0.05 (± 0)	0.63 (± 0)	0.88 (± 0.01)	0.47 (± 0)	0.68 (± 0.1)	1.36 (± 0.01)	1.16 (± 0)	4.16 (± 0.01)
Blooms - IM	0.05 (± 0)	0.63 (± 0)	0.88 (± 0.01)	0.47 (± 0.01)	0.68 (± 0.07)	1.36 (± 0)	1.16 (± 0)	4.16 (± 0.01)
Primary production regime shift - IM	0.06 (± 0.03)	0.63 (± 0)	0.93 (± 0.09)	1.19 (± 1.25)	0.72 (± 0.14)	1.3 (± 0.1)	1.22 (± 0.1)	3.43 (± 1.28)
Fish kills - IM	0.05 (± 0)	0.63 (± 0)	0.88 (± 0.02)	0.47 (± 0.01)	0.68 (± 0.11)	1.36 (± 0.01)	1.16 (± 0)	4.16 (± 0.01)
Range extensions - IM	0.05 (± 0)	0.63 (± 0)	0.88 (± 0)	0.48 (± 0)	0.68 (± 0.03)	1.37 (± 0.01)	1.17 (± 0)	4.16 (± 0.01)
Gear switching allowed - IM	0.05 (± 0)	0.63 (± 0)	0.92 (± 0)	0.51 (± 0.01)	1.02 (± 0.05)	1.34 (± 0)	1.18 (± 0)	4.16 (± 0.01)
High compliance - IM	0.05 (± 0)	0.63 (± 0)	0.88 (± 0.04)	0.47 (± 0.03)	0.71 (± 0.15)	1.36 (± 0.01)	1.17 (± 0.01)	4.16 (± 0.01)
Low Compliance - IM	0.05 (± 0)	0.63 (± 0)	0.85 (± 0.01)	0.45 (± 0.02)	0.65 (± 0.03)	1.37 (± 0.01)	1.16 (± 0)	4.16 (± 0.01)
Flexible fisher behaviour - IM	0.05 (± 0)	0.63 (± 0)	0.9 (± 0)	0.48 (± 0)	0.74 (± 0.09)	1.35 (± 0)	1.17 (± 0)	4.16 (± 0.01)
Increased fishing pressure drivers - IM	0.05 (± 0)	0.63 (± 0)	0.87 (± 0.02)	0.47 (± 0.01)	0.68 (± 0.12)	1.36 (± 0.01)	1.16 (± 0.01)	4.16 (± 0.01)
High Cost, Low Values - IM	0.05 (± 0)	0.63 (± 0)	0.92 (± 0)	0.52 (± 0.01)	1.11 (± 0.02)	1.34 (± 0)	1.18 (± 0)	4.16 (± 0.01)
Low Costs, High Values - IM	0.08 (± 0.05)	0.88 (± 0.43)	1.25 (± 0.61)	0.68 (± 0.34)	1.08 (± 0.53)	1.88 (± 0.91)	1.02 (± 0.26)	4.24 (± 0.14)
Standard Markets - IM	0.05 (± 0)	0.63 (± 0)	0.87 (± 0.02)	0.47 (± 0.01)	0.68 (± 0.12)	1.36 (± 0.01)	1.16 (± 0.01)	4.16 (± 0.01)
Technology Creep - IM	0.05 (± 0)	0.63 (± 0)	0.9 (± 0)	0.51 (± 0.01)	0.86 (± 0.09)	1.34 (± 0)	1.18 (± 0)	4.16 (± 0.01)
No Acclimation - 2010 coastal context - IM	0.02 (± 0)	0.5 (± 0.11)	0.69 (± 0.16)	0.37 (± 0.09)	0.54 (± 0.2)	1.07 (± 0.23)	0.51 (± 0.02)	2.02 (± 0.18)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0.21 (± 0.06)	0.52 (± 0.06)	0.18 (± 0.04)	0.21 (± 0.16)	1.88 (± 0.71)	0.42 (± 0.08)	2.83 (± 0.21)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
No Climate change - 2010 context - SQ	2.43 (± 1.96)	1.52 (± 0.1)	0.93 (± 0.28)	0.88 (± 0.26)	0.98 (± 0.35)	1.7 (± 0.99)	1.14 (± 0.09)	4.14 (± 0.95)
2010 coastal context - Cap ecosystem take	9.64 (± 2.28)	1.15 (± 0.14)	1.48 (± 0.7)	2.81 (± 0.67)	0.82 (± 0.19)	1.36 (± 0.04)	1.04 (± 0.03)	1.39 (± 0.34)
2010 coastal context - Centralised mgmt.	10.99 (± 0.05)	1.23 (± 0)	1.08 (± 0)	3.19 (± 0)	0.92 (± 0)	1.38 (± 0)	1.05 (± 0)	1.59 (± 0)
2010 coastal context - FewMPA	11.18 (± 0.19)	1.1 (± 0)	1.11 (± 0)	3.26 (± 0)	0.93 (± 0)	1.39 (± 0)	1.07 (± 0)	1.6 (± 0)
2010 coastal context - Fragmented mgmt	10.98 (± 0.06)	1.23 (± 0)	1.08 (± 0.01)	3.2 (± 0)	0.93 (± 0)	1.38 (± 0.01)	1.06 (± 0)	1.59 (± 0)
2010 coastal context - ManyMPA	11.13 (± 0.11)	1.22 (± 0)	1.07 (± 0)	3.17 (± 0)	0.91 (± 0)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
2010 coastal context - Seasons	11.11 (± 0.01)	1.22 (± 0)	1.07 (± 0)	3.17 (± 0)	0.91 (± 0)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
2010 coastal context - SlowAssess	10.86 (± 0.25)	1.24 (± 0.01)	1.08 (± 0.01)	2.74 (± 0.79)	0.93 (± 0.01)	1.33 (± 0.09)	1.06 (± 0.01)	1.61 (± 0.03)
2010 coastal context - Integrated Mgmt (IM)	6.3 (± 1.99)	1.71 (± 0.52)	0.82 (± 0.44)	4.46 (± 5.98)	0.79 (± 0.15)	1.21 (± 0.05)	1.13 (± 0.06)	1.79 (± 0.61)

Scenario	Seagrass	Worms	Jellies	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria
Cumulative impacts - 2010 Status Quo (SQ)	11.19 (± 0.08)	1.09 (± 0)	1.16 (± 0)	3.25 (± 0)	1 (± 0)	1.4 (± 0)	1.11 (± 0)	1.64 (± 0)
Cumulative impacts - Cap ecosystem take	9.85 (± 2.4)	1.02 (± 0.12)	1.59 (± 0.74)	2.85 (± 0.68)	0.88 (± 0.21)	1.37 (± 0.04)	1.09 (± 0.03)	1.43 (± 0.35)
Cumulative impacts - Centralised mgmt.	11.2 (± 0.08)	1.09 (± 0)	1.15 (± 0.01)	3.24 (± 0.01)	0.99 (± 0.01)	1.4 (± 0)	1.11 (± 0)	1.63 (± 0)
Cumulative impacts - FewMPA	11.4 (± 0.29)	0.97 (± 0)	1.19 (± 0.01)	3.31 (± 0.01)	0.99 (± 0.01)	1.4 (± 0)	1.12 (± 0)	1.65 (± 0)
Cumulative impacts - Fragmented mgmt	11.2 (± 0.08)	1.09 (± 0)	1.16 (± 0.01)	3.25 (± 0.01)	1 (± 0.01)	1.4 (± 0.01)	1.11 (± 0.01)	1.63 (± 0.01)
Cumulative impacts - ManyMPA	11.35 (± 0.05)	1.08 (± 0)	1.14 (± 0.01)	3.22 (± 0.01)	0.97 (± 0.01)	1.39 (± 0)	1.09 (± 0)	1.62 (± 0)
Cumulative impacts - Seasons	11.33 (± 0.1)	1.08 (± 0)	1.14 (± 0.01)	3.22 (± 0.01)	0.97 (± 0.01)	1.39 (± 0)	1.1 (± 0)	1.62 (± 0)
Cumulative impacts - SlowAssess	11.46 (± 0.48)	1.1 (± 0.01)	1.16 (± 0)	2.78 (± 0.8)	0.99 (± 0.01)	1.34 (± 0.09)	1.12 (± 0.02)	1.65 (± 0.03)
Cumulative impacts - IM	7.66 (± 3.23)	1.52 (± 0.46)	0.88 (± 0.47)	4.52 (± 6.07)	0.85 (± 0.15)	1.22 (± 0.05)	1.18 (± 0.06)	1.57 (± 0.74)
Expanded LTL fishery - IM	11.07 (± 0.07)	1.24 (± 0)	1.08 (± 0)	3.19 (± 0.01)	0.92 (± 0.01)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
New mesopelgic fishery - IM	11.08 (± 0.06)	1.24 (± 0)	1.08 (± 0)	3.19 (± 0.01)	0.92 (± 0.01)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
Extreme climate events - IM	10.98 (± 0.05)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0)	0.93 (± 0)	1.39 (± 0)	1.06 (± 0)	1.59 (± 0)
Blooms - IM	10.98 (± 0.05)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0)	0.94 (± 0.01)	1.39 (± 0)	1.06 (± 0)	1.59 (± 0)
Primary production regime shift - IM	9.27 (± 2.95)	1.24 (± 0.01)	1.08 (± 0.01)	2.74 (± 0.8)	0.93 (± 0.01)	1.33 (± 0.09)	1.07 (± 0.01)	1.61 (± 0.03)
Fish kills - IM	10.97 (± 0.04)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0.01)	0.93 (± 0.01)	1.39 (± 0)	1.06 (± 0)	1.59 (± 0)
Range extensions - IM	10.96 (± 0.07)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0)	0.93 (± 0)	1.39 (± 0)	1.06 (± 0)	1.59 (± 0.01)
Gear switching allowed - IM	11.15 (± 0.06)	1.22 (± 0)	1.06 (± 0)	3.17 (± 0)	0.91 (± 0)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
High compliance - IM	10.98 (± 0.04)	1.23 (± 0)	1.08 (± 0.01)	3.2 (± 0.01)	0.93 (± 0.02)	1.38 (± 0.01)	1.06 (± 0.01)	1.59 (± 0)
Low Compliance - IM	10.98 (± 0.04)	1.23 (± 0)	1.09 (± 0.01)	3.21 (± 0.01)	0.94 (± 0.01)	1.39 (± 0)	1.07 (± 0)	1.59 (± 0)
Flexible fisher behaviour - IM	10.99 (± 0.05)	1.23 (± 0)	1.07 (± 0)	3.19 (± 0.01)	0.93 (± 0)	1.38 (± 0)	1.05 (± 0)	1.59 (± 0)
Increased fishing pressure drivers - IM	10.97 (± 0.04)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0.01)	0.93 (± 0.01)	1.39 (± 0)	1.06 (± 0.01)	1.59 (± 0)
High Cost, Low Values - IM	11.12 (± 0)	1.22 (± 0)	1.07 (± 0)	3.17 (± 0)	0.91 (± 0)	1.38 (± 0)	1.04 (± 0)	1.58 (± 0)
Low Costs, High Values - IM	10.32 (± 1.1)	1.07 (± 0.27)	1.88 (± 1.39)	2.42 (± 1.34)	0.7 (± 0.39)	1.34 (± 0.08)	1.02 (± 0.06)	1.2 (± 0.67)
Standard Markets - IM	10.97 (± 0.04)	1.23 (± 0)	1.08 (± 0)	3.2 (± 0.01)	0.93 (± 0.01)	1.39 (± 0)	1.06 (± 0.01)	1.59 (± 0)
Technology Creep - IM	11.07 (± 0.03)	1.23 (± 0)	1.07 (± 0)	3.18 (± 0)	0.91 (± 0)	1.38 (± 0)	1.05 (± 0)	1.58 (± 0)
No Acclimation - 2010 coastal context - IM	15.98 (± 1.39)	0.7 (± 0.27)	1.23 (± 0.37)	1.07 (± 0.91)	0.87 (± 0.71)	1.18 (± 0.49)	1.19 (± 0.18)	5.6 (± 6.43)
No Acclimation - Cumulative impacts - SQ	28.02 (± 12.66)	0.58 (± 0.47)	2.61 (± 2.66)	3.82 (± 3.93)	0.98 (± 0.59)	1.37 (± 0.6)	1.14 (± 0.15)	2.53 (± 2.46)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	2.18 (± 0.7)	0.7 (± 0.23)	106.33 (± 86.88)	29.89 (± 13.06)
2010 coastal context - Cap ecosystem take	3.79 (± 0.9)	2.12 (± 0.25)	3.47 (± 0.82)	2.53 (± 0.6)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
2010 coastal context - Centralised mgmt.	4.3 (± 0.03)	2.26 (± 0.01)	3.94 (± 0.02)	2.87 (± 0.01)
2010 coastal context - FewMPA	4.44 (± 0.02)	2.33 (± 0)	4.06 (± 0.02)	2.91 (± 0)
2010 coastal context - Fragmented mgmt	4.31 (± 0.03)	2.27 (± 0.01)	3.95 (± 0.03)	2.88 (± 0.02)
2010 coastal context - ManyMPA	4.22 (± 0)	2.23 (± 0)	3.87 (± 0)	2.82 (± 0)
2010 coastal context - Seasons	4.22 (± 0)	2.23 (± 0)	3.87 (± 0)	2.82 (± 0)
2010 coastal context - SlowAssess	4.44 (± 0.2)	2.42 (± 0.25)	4.05 (± 0.15)	3.03 (± 0.25)
2010 coastal context - Integrated Mgmt (IM)	3.95 (± 0.71)	0.84 (± 0.36)	38.86 (± 32.28)	16.01 (± 10.99)
Cumulative impacts - 2010 Status Quo (SQ)	4.49 (± 0.01)	2.48 (± 0)	4.12 (± 0.01)	3.04 (± 0.01)
Cumulative impacts - Cap ecosystem take	3.92 (± 0.94)	2.32 (± 0.28)	3.6 (± 0.86)	2.66 (± 0.64)
Cumulative impacts - Centralised mgmt.	4.45 (± 0.03)	2.47 (± 0.01)	4.08 (± 0.02)	3.01 (± 0.02)
Cumulative impacts - FewMPA	4.61 (± 0.01)	2.54 (± 0.01)	4.21 (± 0.01)	3.06 (± 0.02)
Cumulative impacts - Fragmented mgmt	4.47 (± 0.05)	2.48 (± 0.02)	4.1 (± 0.04)	3.02 (± 0.04)
Cumulative impacts - ManyMPA	4.37 (± 0.02)	2.44 (± 0.01)	4.01 (± 0.02)	2.96 (± 0.02)
Cumulative impacts - Seasons	4.37 (± 0.02)	2.44 (± 0.01)	4.01 (± 0.02)	2.96 (± 0.02)
Cumulative impacts - SlowAssess	4.6 (± 0.23)	2.64 (± 0.29)	4.2 (± 0.18)	3.18 (± 0.29)
Cumulative impacts - IM	4.34 (± 0.86)	0.92 (± 0.39)	40.39 (± 33.63)	16.82 (± 11.55)
Expanded LTL fishery - IM	4.42 (± 0.01)	2.26 (± 0.01)	4.03 (± 0.01)	2.9 (± 0.01)
New mesopelgic fishery - IM	4.4 (± 0.03)	2.26 (± 0.01)	4.02 (± 0.03)	2.89 (± 0.02)
Extreme climate events - IM	4.33 (± 0.03)	2.27 (± 0.01)	3.97 (± 0.02)	2.89 (± 0.01)
Blooms - IM	4.33 (± 0.01)	2.27 (± 0)	3.97 (± 0.01)	2.89 (± 0.01)
Primary production regime shift - IM	4.44 (± 0.2)	2.42 (± 0.26)	4.05 (± 0.15)	3.03 (± 0.25)
Fish kills - IM	4.33 (± 0.02)	2.27 (± 0.01)	3.97 (± 0.02)	2.89 (± 0.02)
Range extensions - IM	4.34 (± 0.03)	2.28 (± 0.01)	3.98 (± 0.03)	2.9 (± 0.02)
Gear switching allowed - IM	4.22 (± 0)	2.23 (± 0)	3.87 (± 0)	2.82 (± 0)
High compliance - IM	4.31 (± 0.06)	2.27 (± 0.02)	3.95 (± 0.06)	2.88 (± 0.04)
Low Compliance - IM	4.37 (± 0.02)	2.29 (± 0.01)	4 (± 0.02)	2.92 (± 0.01)
Flexible fisher behaviour - IM	4.29 (± 0.01)	2.26 (± 0)	3.93 (± 0.01)	2.87 (± 0.01)
Increased fishing pressure drivers - IM	4.33 (± 0.03)	2.27 (± 0.01)	3.97 (± 0.03)	2.89 (± 0.02)
High Cost, Low Values - IM	4.22 (± 0)	2.23 (± 0)	3.87 (± 0)	2.82 (± 0)
Low Costs, High Values - IM	3.24 (± 1.82)	1.97 (± 0.5)	2.97 (± 1.67)	2.17 (± 1.22)
Standard Markets - IM	4.33 (± 0.03)	2.27 (± 0.01)	3.97 (± 0.03)	2.89 (± 0.02)

Scenario	Sediment bacteria	Meiobenthos	Labile detritus	Refractory detritus
Technology Creep - IM	4.24 (± 0.01)	2.24 (± 0)	3.88 (± 0.01)	2.83 (± 0.01)
No Acclimation - 2010 coastal context - IM	13.53 (± 18.4)	0.99 (± 0.04)	144.35 (± 221.97)	28.63 (± 30.82)
No Acclimation - Cumulative impacts - SQ	60.24 (± 91.65)	3.16 (± 1.36)	193.81 (± 333.87)	19.09 (± 30.21)

Table A. 4: Mean relative landings (± s.e.) 2065-2070 of each fished group in Atlantis-SE for each strategy-scenario combination under RCP 3. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics "Major fishery" is noted as there is no fishery initially.

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	0.88 (± 0.91)	55.46 (± 85.7)	1.19 (± 1.3)	0.42 (± 0.43)	0.4 (± 0.28)	31.22 (± 29.01)	2.9 (± 1.42)
2010 coastal context - Cap ecosystem take	1.73 (± 2.25)	23.02 (± 24.61)	0.2 (± 0.28)	1.87 (± 1.74)	0.23 (± 0.15)	13.97 (± 11.1)	1.66 (± 2.19)
2010 coastal context - Centralised mgmt.	1.73 (± 2.26)	22.94 (± 23.75)	0.2 (± 0.28)	10.24 (± 12.92)	0.45 (± 0.44)	7.88 (± 6.83)	2.33 (± 3.4)
2010 coastal context - FewMPA	1.74 (± 2.29)	14.38 (± 5.93)	0.12 (± 0.17)	738.38 (± 857.84)	64.9 (± 103.18)	38.4 (± 42.12)	6.42 (± 5.57)
2010 coastal context - Fragmented mgmt	1.73 (± 2.25)	27.78 (± 36.99)	0.2 (± 0.28)	11.32 (± 16.52)	0.8 (± 0.69)	9.74 (± 8.66)	3.2 (± 4.35)
2010 coastal context - ManyMPA	1.68 (± 2.18)	30.74 (± 17.84)	0.16 (± 0.22)	0 (± 0)	0 (± 0)	31.89 (± 33.77)	1.84 (± 2.64)
2010 coastal context - Seasons	1.15 (± 1.52)	5.09 (± 3.8)	0.14 (± 0.21)	114.77 (± 100.25)	77.16 (± 132.19)	59.65 (± 59.82)	21.75 (± 27.87)
2010 coastal context - SlowAssess	1.72 (± 2.25)	13.34 (± 7.44)	0.21 (± 0.28)	12.37 (± 12.72)	2.24 (± 3.23)	12.99 (± 11.67)	0.97 (± 0.96)
2010 coastal context - Integrated Mgmt (IM)	1.73 (± 2.25)	23.02 (± 24.61)	0.2 (± 0.28)	1.87 (± 1.74)	0.23 (± 0.15)	28.56 (± 16.24)	1.66 (± 2.19)
Cumulative impacts - 2010 Status Quo (SQ)	1.69 (± 2.2)	11.92 (± 7.67)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	1.68 (± 1.27)	1.15 (± 1.8)
Cumulative impacts - Cap ecosystem take	1.69 (± 2.19)	17.88 (± 12.4)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	1.09 (± 0.63)	0.64 (± 0.87)
Cumulative impacts - Centralised mgmt.	1.69 (± 2.2)	19.28 (± 16.5)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	0.77 (± 0.69)	0.87 (± 1.37)
Cumulative impacts - FewMPA	1.7 (± 2.22)	16.53 (± 13.1)	0.11 (± 0.15)	0 (± 0)	0 (± 0)	2.82 (± 2.46)	1.57 (± 2.16)
Cumulative impacts - Fragmented mgmt	1.69 (± 2.19)	15.89 (± 8.57)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	0.74 (± 0.48)	1.2 (± 1.76)
Cumulative impacts - ManyMPA	1.64 (± 2.12)	38.28 (± 42.04)	0.15 (± 0.21)	0 (± 0)	0 (± 0)	2.36 (± 1.96)	0.67 (± 1.09)
Cumulative impacts - Seasons	1.13 (± 1.47)	5.49 (± 5.54)	0.13 (± 0.2)	0 (± 0)	0 (± 0)	4.42 (± 3.4)	2.83 (± 2.46)
Cumulative impacts - SlowAssess	1.69 (± 2.19)	16.97 (± 18.8)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	1 (± 0.68)	0.33 (± 0.4)
Cumulative impacts - IM	1.69 (± 2.19)	17.88 (± 12.4)	0.19 (± 0.26)	0 (± 0)	0 (± 0)	2.7 (± 2.26)	0.64 (± 0.87)
Expanded LTL fishery - IM	1.73 (± 2.26)	22.53 (± 19.53)	0.2 (± 0.28)	35.2 (± 42.97)	2.08 (± 1.72)	2.1 (± 3.64)	3.59 (± 5.01)
New mesopelgic fishery - IM	1.87 (± 2.45)	43.37 (± 52.7)	0.49 (± 0.7)	5.84 (± 9.16)	0.58 (± 0.37)	3.46 (± 4.83)	23.21 (± 35.47)
Extreme climate events - IM	1.88 (± 2.46)	44.42 (± 54.4)	0.48 (± 0.67)	0.01 (± 0.02)	0.03 (± 0.02)	9.35 (± 6.39)	11.65 (± 12.18)
Blooms - IM	1.86 (± 2.43)	45.42 (± 54.6)	0.48 (± 0.68)	0.01 (± 0.01)	0.04 (± 0.06)	24.68 (± 23.16)	9.05 (± 11.92)
Primary production regime shift - IM	1.94 (± 2.55)	44.78 (± 54.22)	0.47 (± 0.67)	46.77 (± 80.99)	0.54 (± 0.9)	11.8 (± 9.94)	9.8 (± 8.72)

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
Fish kills - IM	1.87 (± 2.45)	42.46 (± 52.57)	0.48 (± 0.67)	0.03 (± 0.01)	0.03 (± 0.04)	10.65 (± 13.21)	4.2 (± 2.9)
Range extensions - IM	1.73 (± 2.25)	11.1 (± 5.92)	0.21 (± 0.28)	15.34 (± 15.28)	35.71 (± 58.59)	14.36 (± 14.8)	3.56 (± 5.05)
Gear switching allowed - IM	1.71 (± 2.24)	13.4 (± 10.08)	0.12 (± 0.16)	225.27 (± 372.89)	16.07 (± 16.91)	31.22 (± 43.23)	1.11 (± 1.29)
High compliance - IM	1.73 (± 2.26)	16.81 (± 8.47)	0.2 (± 0.28)	15.27 (± 25.45)	0.57 (± 0.3)	6.87 (± 6.26)	2.14 (± 2.2)
Low Compliance - IM	1.73 (± 2.25)	15.7 (± 13.91)	0.21 (± 0.29)	1.32 (± 1.41)	0.32 (± 0.5)	23.52 (± 24.45)	3.64 (± 5.65)
Flexible fisher behaviour - IM	4.78 (± 6.24)	20.15 (± 16.59)	0.53 (± 0.73)	16.32 (± 15.47)	1.32 (± 1.58)	3.35 (± 5.8)	2.77 (± 3.62)
Increased fishing pressure drivers - IM	1.73 (± 2.25)	23.02 (± 24.61)	0.2 (± 0.28)	1.87 (± 1.74)	0.23 (± 0.15)	22.46 (± 23.75)	1.66 (± 2.19)
High Cost, Low Values - IM	1.75 (± 2.28)	28.6 (± 29.6)	0.12 (± 0.16)	592.92 (± 511.29)	100.71 (± 107.2)	37.85 (± 40.88)	16.33 (± 16.21)
Low Costs, High Values - IM	1.72 (± 2.25)	27.65 (± 35.63)	0.2 (± 0.28)	10.23 (± 15.82)	0.23 (± 0.09)	3.19 (± 4.48)	1.17 (± 1.34)
Standard Markets - IM	1.73 (± 2.26)	16.31 (± 18.37)	0.2 (± 0.28)	9.4 (± 13.19)	0.93 (± 0.7)	22.47 (± 22.23)	3.26 (± 4.33)
Technology Creep - IM	3.3 (± 4.32)	29.98 (± 17.12)	0.34 (± 0.46)	225.47 (± 195.86)	9.2 (± 6.32)	11.26 (± 19.26)	2.95 (± 3.51)
No Acclimation - 2010 coastal context - IM	0 (± 0)	0 (± 0)	0 (± 0)	23.12 (± 20.03)	229.4 (± 395.89)	3.23 (± 1.83)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0 (± 0)	0 (± 0)	0 (± 0)	0 (± 0)	2.28 (± 2.8)	0 (± 0)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	0.03 (± 0.02)	1.23 (± 0.45)	0 (± 0)	0 (± 0)	0.71 (± 0.74)	0.15 (± 0.09)	0.83 (± 0.43)	2.3 (± 3.41)
2010 coastal context - Cap ecosystem take	0.02 (± 0.02)	0.85 (± 0.87)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.56 (± 0.72)	0.31 (± 0.2)	1.89 (± 3.04)
2010 coastal context - Centralised mgmt.	0.02 (± 0.02)	0.64 (± 0.59)	0 (± 0)	0 (± 0)	0.14 (± 0.14)	0.39 (± 0.35)	0.34 (± 0.34)	3.68 (± 4.12)
2010 coastal context - FewMPA	0.02 (± 0.02)	0.94 (± 0.81)	0 (± 0)	0 (± 0)	0.12 (± 0.12)	0.79 (± 0.5)	0.44 (± 0.73)	56.71 (± 49.36)
2010 coastal context - Fragmented mgmt	0.02 (± 0.02)	0.8 (± 0.81)	0 (± 0)	0 (± 0)	0.16 (± 0.15)	0.7 (± 0.84)	0.44 (± 0.49)	1.74 (± 1.91)
2010 coastal context - ManyMPA	0.02 (± 0.02)	0.64 (± 0.65)	0 (± 0)	0 (± 0)	0.13 (± 0.14)	0.01 (± 0.02)	1.7 (± 2.22)	0 (± 0)
2010 coastal context - Seasons	0 (± 0)	0.64 (± 0.6)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.18 (± 0.07)	0.45 (± 0.67)	38.3 (± 32.8)
2010 coastal context - SlowAssess	0.02 (± 0.02)	0.55 (± 0.55)	0 (± 0)	0 (± 0)	0.14 (± 0.15)	0.49 (± 0.46)	0.15 (± 0.16)	28.33 (± 47.62)
2010 coastal context - Integrated Mgmt (IM)	0.02 (± 0.02)	0.85 (± 0.87)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.56 (± 0.72)	0.31 (± 0.2)	1.89 (± 3.04)
Cumulative impacts - 2010 Status Quo (SQ)	0.02 (± 0.02)	0.68 (± 0.85)	0 (± 0)	0 (± 0)	0.16 (± 0.16)	0.1 (± 0.15)	0.18 (± 0.26)	0 (± 0)
Cumulative impacts - Cap ecosystem take	0.02 (± 0.02)	0.71 (± 0.9)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.16 (± 0.26)	0.12 (± 0.11)	0 (± 0)
Cumulative impacts - Centralised mgmt.	0.02 (± 0.02)	0.51 (± 0.59)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.09 (± 0.15)	0.14 (± 0.18)	0 (± 0)
Cumulative impacts - FewMPA	0.02 (± 0.02)	0.72 (± 0.75)	0 (± 0)	0 (± 0)	0.13 (± 0.12)	0.15 (± 0.24)	0.21 (± 0.35)	0 (± 0)
Cumulative impacts - Fragmented mgmt	0.02 (± 0.02)	0.66 (± 0.83)	0 (± 0)	0 (± 0)	0.17 (± 0.16)	0.19 (± 0.31)	0.19 (± 0.25)	0 (± 0)
Cumulative impacts - ManyMPA	0.02 (± 0.02)	0.42 (± 0.37)	0 (± 0)	0 (± 0)	0.14 (± 0.15)	0 (± 0.01)	0.76 (± 1.12)	0 (± 0)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
Cumulative impacts - Seasons	0 (± 0)	0.44 (± 0.37)	0 (± 0)	0 (± 0)	0.17 (± 0.16)	0.03 (± 0.04)	0.21 (± 0.33)	0 (± 0)
Cumulative impacts - SlowAssess	0.02 (± 0.02)	0.45 (± 0.56)	0 (± 0)	0 (± 0)	0.16 (± 0.15)	0.12 (± 0.19)	0.06 (± 0.08)	0 (± 0)
Cumulative impacts - IM	0.02 (± 0.02)	0.71 (± 0.9)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.16 (± 0.26)	0.12 (± 0.11)	0 (± 0)
Expanded LTL fishery - IM	0.02 (± 0.02)	0.92 (± 0.8)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.65 (± 0.56)	0.35 (± 0.37)	9.34 (± 10.59)
New mesopelgic fishery - IM	0 (± 0)	0.79 (± 0.68)	Major fishery	Major fishery	0.26 (± 0.26)	0.19 (± 0.21)	0.23 (± 0.34)	3.97 (± 4.33)
Extreme climate events - IM	0 (± 0)	0.73 (± 0.8)	0 (± 0)	0 (± 0)	0.27 (± 0.25)	0.12 (± 0.19)	0.14 (± 0.2)	0.04 (± 0.04)
Blooms - IM	0 (± 0)	0.62 (± 0.63)	0 (± 0)	0 (± 0)	0.26 (± 0.25)	0.14 (± 0.2)	0.11 (± 0.16)	0.04 (± 0.08)
Primary production regime shift - IM	0 (± 0)	0.71 (± 0.79)	0 (± 0)	0 (± 0)	0.27 (± 0.25)	0.21 (± 0.25)	0.16 (± 0.13)	7.37 (± 12.71)
Fish kills - IM	0 (± 0)	0.61 (± 0.78)	0 (± 0)	0 (± 0)	0.27 (± 0.25)	0.13 (± 0.2)	0.06 (± 0.08)	0.04 (± 0.05)
Range extensions - IM	0.02 (± 0.02)	0.91 (± 0.92)	0 (± 0)	0 (± 0)	0.14 (± 0.15)	0.43 (± 0.43)	0.39 (± 0.4)	49.8 (± 85.71)
Gear switching allowed - IM	0.02 (± 0.02)	0.96 (± 0.96)	0 (± 0)	0 (± 0)	0.12 (± 0.12)	0.29 (± 0.16)	0.55 (± 0.75)	30.14 (± 28.8)
High compliance - IM	0.02 (± 0.02)	0.46 (± 0.44)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.62 (± 0.81)	0.34 (± 0.24)	5.01 (± 4.62)
Low Compliance - IM	0.02 (± 0.02)	0.48 (± 0.43)	0 (± 0)	0 (± 0)	0.14 (± 0.13)	0.4 (± 0.44)	0.57 (± 0.84)	0.04 (± 0.05)
Flexible fisher behaviour - IM	0.06 (± 0.05)	0.71 (± 0.6)	0 (± 0)	0 (± 0)	0.28 (± 0.3)	0.5 (± 0.47)	0.34 (± 0.21)	6.78 (± 7.21)
Increased fishing pressure drivers - IM	0.02 (± 0.02)	0.85 (± 0.87)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.56 (± 0.72)	0.31 (± 0.2)	1.89 (± 3.04)
High Cost, Low Values - IM	0.02 (± 0.02)	0.93 (± 0.81)	0 (± 0)	0 (± 0)	0.16 (± 0.2)	0.61 (± 0.12)	0.28 (± 0.34)	56.72 (± 53.99)
Low Costs, High Values - IM	0.02 (± 0.02)	0.74 (± 0.8)	0 (± 0)	0 (± 0)	0.15 (± 0.14)	0.56 (± 0.7)	0.35 (± 0.22)	1.88 (± 1.75)
Standard Markets - IM	0.02 (± 0.02)	0.81 (± 0.83)	0 (± 0)	0 (± 0)	0.14 (± 0.15)	0.43 (± 0.33)	0.41 (± 0.51)	2.72 (± 2.9)
Technology Creep - IM	0.04 (± 0.04)	0.89 (± 0.93)	0 (± 0)	0 (± 0)	0.23 (± 0.25)	0.56 (± 0.41)	0.51 (± 0.71)	42.86 (± 50.78)
No Acclimation - 2010 coastal context - IM	0 (± 0)	0.27 (± 0.28)	0 (± 0)	0 (± 0)	0 (± 0)	8.36 (± 10.77)	1.36 (± 0.86)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0.22 (± 0.27)	0 (± 0)	0 (± 0)	0 (± 0)	5.01 (± 6.17)	1.03 (± 0.94)	0 (± 0)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	0.6 (± 0.1)	1.39 (± 0.9)	4.23 (± 4.95)	2.01 (± 2.16)	0.36 (± 0.5)	1.79 (± 1.46)	1.98 (± 1.23)	1.73 (± 0.07)
2010 coastal context - Cap ecosystem take	0.33 (± 0.36)	1.02 (± 0.76)	0.27 (± 0.43)	0.49 (± 0.22)	0.6 (± 0.88)	0.68 (± 0.38)	2.76 (± 1.96)	2.15 (± 1.21)
2010 coastal context - Centralised mgmt.	0.21 (± 0.22)	1.28 (± 1.08)	0.21 (± 0.34)	0.48 (± 0.3)	0.42 (± 0.51)	0.72 (± 0.13)	2.28 (± 1.45)	1.54 (± 0.22)
2010 coastal context - FewMPA	0.12 (± 0.04)	4.04 (± 4.97)	0.33 (± 0.56)	0.7 (± 0.59)	0.9 (± 0.85)	0.31 (± 0.36)	0 (± 0)	2.21 (± 1.71)
2010 coastal context - Fragmented mgmt	0.02 (± 0.03)	1.83 (± 1.56)	0.11 (± 0.17)	0.59 (± 0.44)	0.77 (± 1.11)	0.73 (± 0.44)	2.56 (± 1.25)	1.66 (± 0.62)
2010 coastal context - ManyMPA	0.24 (± 0.18)	0.23 (± 0.34)	0.97 (± 1.61)	0.57 (± 0.95)	0.18 (± 0.31)	2.35 (± 2.42)	0.47 (± 0.42)	2.17 (± 1.43)
2010 coastal context - Seasons	0.06 (± 0.03)	1.86 (± 2.37)	0.69 (± 1.18)	1.4 (± 0.95)	0.36 (± 0.59)	2.63 (± 2.66)	0 (± 0)	3.95 (± 2.49)
2010 coastal context - SlowAssess	0.09 (± 0.05)	1.3 (± 1.06)	0.16 (± 0.26)	1.08 (± 1.06)	0.5 (± 0.64)	0.42 (± 0.17)	2.09 (± 1.77)	1.03 (± 0.5)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
2010 coastal context - Integrated Mgmt (IM)	0.33 (± 0.36)	1.02 (± 0.76)	0.27 (± 0.43)	0.49 (± 0.22)	0.6 (± 0.88)	0.68 (± 0.38)	2.76 (± 1.96)	2.15 (± 1.21)
Cumulative impacts - 2010 Status Quo (SQ)	0.22 (± 0.34)	0.38 (± 0.48)	0.09 (± 0.15)	0.66 (± 0.37)	0.24 (± 0.41)	0.19 (± 0.19)	2.15 (± 1.2)	0.6 (± 0.39)
Cumulative impacts - Cap ecosystem take	66.91 (± 115.84)	0.28 (± 0.24)	0.23 (± 0.39)	0.5 (± 0.33)	0.46 (± 0.78)	0.24 (± 0.2)	2.68 (± 2.28)	0.91 (± 0.71)
Cumulative impacts - Centralised mgmt.	41.09 (± 71.12)	0.29 (± 0.31)	0.18 (± 0.31)	0.41 (± 0.14)	0.29 (± 0.49)	0.28 (± 0.21)	2.15 (± 1.54)	0.66 (± 0.45)
Cumulative impacts - FewMPA	14.71 (± 25.42)	0.37 (± 0.24)	0.29 (± 0.5)	1.06 (± 1.42)	0.52 (± 0.89)	0.22 (± 0.32)	0 (± 0)	1.29 (± 1.46)
Cumulative impacts - Fragmented mgmt	0.21 (± 0.34)	0.45 (± 0.45)	0.09 (± 0.15)	0.52 (± 0.27)	0.58 (± 1)	0.33 (± 0.27)	2.34 (± 1.04)	0.71 (± 0.5)
Cumulative impacts - ManyMPA	34.53 (± 59.69)	0.07 (± 0.09)	0.85 (± 1.45)	0.34 (± 0.52)	0.15 (± 0.26)	1.61 (± 2.18)	0.4 (± 0.3)	1.21 (± 1.16)
Cumulative impacts - Seasons	8.65 (± 14.96)	0.14 (± 0.13)	0.61 (± 1.06)	1.99 (± 2.44)	0.29 (± 0.5)	1.79 (± 2.41)	0 (± 0)	2.18 (± 2.1)
Cumulative impacts - SlowAssess	13.22 (± 22.86)	0.23 (± 0.2)	0.14 (± 0.24)	1.89 (± 2.79)	0.35 (± 0.6)	0.21 (± 0.25)	1.96 (± 1.86)	0.54 (± 0.52)
Cumulative impacts - IM	66.91 (± 115.84)	0.28 (± 0.24)	0.23 (± 0.39)	0.5 (± 0.33)	0.46 (± 0.78)	0.24 (± 0.2)	2.68 (± 2.28)	0.91 (± 0.71)
Expanded LTL fishery - IM	0.2 (± 0.19)	2.2 (± 1.93)	0.15 (± 0.24)	0.53 (± 0.35)	0.64 (± 0.79)	0.76 (± 0.01)	1.74 (± 1.18)	1.37 (± 0.28)
New mesopelgic fishery - IM	0.12 (± 0.14)	1.06 (± 0.92)	0.35 (± 0.59)	1.05 (± 1.43)	0.1 (± 0.12)	0.89 (± 1.1)	20.74 (± 13.39)	2.51 (± 1.02)
Extreme climate events - IM	0.16 (± 0.21)	0.41 (± 0.31)	0.59 (± 0.99)	0.71 (± 0.82)	0.07 (± 0.11)	0.48 (± 0.41)	20.85 (± 9.99)	2.71 (± 0.47)
Blooms - IM	0.15 (± 0.2)	0.38 (± 0.32)	0.51 (± 0.86)	0.75 (± 0.95)	0.08 (± 0.12)	0.32 (± 0.24)	26.27 (± 13.23)	1.73 (± 0.47)
Primary production regime shift - IM	0.22 (± 0.26)	0.88 (± 0.91)	0.56 (± 0.95)	1.5 (± 1.07)	0.11 (± 0.14)	1.23 (± 0.99)	12.55 (± 9.24)	2.6 (± 0.71)
Fish kills - IM	0.06 (± 0.06)	0.27 (± 0.18)	0.62 (± 1.04)	0.64 (± 0.81)	0.07 (± 0.12)	0.56 (± 0.45)	28.27 (± 19.78)	2.11 (± 0.57)
Range extensions - IM	0.32 (± 0.23)	1.6 (± 1.28)	0.22 (± 0.36)	1.21 (± 1.01)	0.6 (± 0.83)	0.48 (± 0.2)	2.6 (± 2.23)	1.38 (± 0.84)
Gear switching allowed - IM	0.23 (± 0.22)	1.42 (± 1.37)	0.02 (± 0.02)	1.14 (± 1.06)	0.25 (± 0.24)	1.46 (± 1.52)	0.09 (± 0.04)	1.32 (± 0.89)
High compliance - IM	0.23 (± 0.23)	1.16 (± 1.05)	0.26 (± 0.44)	0.48 (± 0.19)	0.63 (± 0.9)	1.21 (± 0.99)	2.09 (± 1.29)	2.27 (± 1.62)
Low Compliance - IM	0.1 (± 0.06)	1.52 (± 1.4)	0.02 (± 0.02)	0.57 (± 0.25)	0.42 (± 0.57)	1.91 (± 2.46)	2.71 (± 2.06)	2.17 (± 1.37)
Flexible fisher behaviour - IM	0.31 (± 0.35)	1.56 (± 1.28)	0.26 (± 0.44)	0.56 (± 0.21)	0.5 (± 0.62)	0.99 (± 0.85)	2.2 (± 1.5)	2.2 (± 1.76)
Increased fishing pressure drivers - IM	0.33 (± 0.36)	1.02 (± 0.76)	0.27 (± 0.43)	0.49 (± 0.22)	0.6 (± 0.88)	0.68 (± 0.38)	2.76 (± 1.96)	2.15 (± 1.21)
High Cost, Low Values - IM	0.19 (± 0.2)	5.57 (± 4.8)	0.07 (± 0.11)	0.71 (± 0.66)	0.55 (± 0.34)	0.72 (± 0.71)	0 (± 0)	2.29 (± 1.47)
Low Costs, High Values - IM	0.2 (± 0.16)	1.03 (± 0.78)	1.81 (± 3.03)	0.5 (± 0.14)	0.6 (± 0.84)	1.01 (± 0.88)	2.27 (± 1.09)	2.21 (± 1.8)
Standard Markets - IM	0.05 (± 0.05)	1.89 (± 1.65)	0.11 (± 0.17)	0.69 (± 0.36)	0.36 (± 0.43)	0.58 (± 0.4)	2.38 (± 1.45)	1.48 (± 0.16)
Technology Creep - IM	0.35 (± 0.43)	2.23 (± 1.83)	0.27 (± 0.45)	0.52 (± 0.28)	0.58 (± 0.68)	0.99 (± 0.84)	0.62 (± 0.63)	1.8 (± 1.13)
No Acclimation - 2010 coastal context - IM	0.06 (± 0.07)	5.45 (± 4.1)	0.94 (± 1.53)	0.01 (± 0.01)	1.16 (± 1.72)	0 (± 0)	0.03 (± 0.02)	3.18 (± 1.78)
No Acclimation - Cumulative impacts - SQ	0.05 (± 0.06)	5.83 (± 5.76)	0.34 (± 0.53)	0.02 (± 0)	0.65 (± 0.9)	0 (± 0)	0.02 (± 0.01)	2.01 (± 0.53)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
No Climate change - 2010 context - SQ	0.77 (± 0.64)	9.83 (± 6.61)	1.23 (± 0.36)	0.74 (± 0.86)	1.56 (± 0.71)	0.2 (± 0.11)	5.51 (± 4.72)	0.19 (± 0.07)
2010 coastal context - Cap ecosystem take	2.26 (± 1.87)	8.35 (± 5.77)	1.39 (± 0.74)	8.92 (± 15.26)	1.24 (± 0.92)	0.2 (± 0.07)	3.36 (± 4.73)	0.13 (± 0.11)
2010 coastal context - Centralised mgmt.	1.47 (± 0.61)	8.33 (± 5.73)	1.3 (± 0.8)	9.35 (± 15.98)	1.26 (± 0.94)	0.23 (± 0.15)	7.79 (± 11.15)	0.14 (± 0.12)
2010 coastal context - FewMPA	0.26 (± 0.25)	10.56 (± 7.25)	19.64 (± 15.87)	6.26 (± 10.73)	0.7 (± 0.53)	0.09 (± 0.12)	55.16 (± 86.1)	0.19 (± 0.16)
2010 coastal context - Fragmented mgmt	1.93 (± 1.14)	8.35 (± 5.75)	1.35 (± 0.88)	8.1 (± 13.83)	1.27 (± 0.94)	0.21 (± 0.11)	7.16 (± 9.83)	0.14 (± 0.13)
2010 coastal context - ManyMPA	0.08 (± 0.05)	9.41 (± 6.58)	6.71 (± 5.61)	0.03 (± 0.06)	1.34 (± 1)	0.07 (± 0.07)	0.62 (± 0.94)	1.55 (± 1.31)
2010 coastal context - Seasons	0.79 (± 0.45)	40.94 (± 28.21)	88.49 (± 62.67)	12.01 (± 20.57)	0.4 (± 0.32)	0.12 (± 0.13)	84.15 (± 127.52)	0.1 (± 0.09)
2010 coastal context - SlowAssess	0.69 (± 0.16)	10.53 (± 7.26)	1.31 (± 0.64)	9.07 (± 15.5)	1.31 (± 1)	0.2 (± 0.17)	3.75 (± 4.22)	0.16 (± 0.1)
2010 coastal context - Integrated Mgmt (IM)	2.26 (± 1.87)	8.35 (± 5.77)	1.39 (± 0.74)	8.92 (± 15.26)	1.24 (± 0.92)	0.2 (± 0.07)	22.05 (± 29.96)	0.13 (± 0.11)
Cumulative impacts - 2010 Status Quo (SQ)	0.17 (± 0.12)	8.18 (± 5.63)	4.06 (± 2.95)	3.43 (± 5.85)	1.38 (± 1.04)	0.1 (± 0.12)	0.01 (± 0.01)	0.03 (± 0.03)
Cumulative impacts - Cap ecosystem take	0.2 (± 0.09)	8.2 (± 5.66)	4.61 (± 3.14)	3.69 (± 6.31)	1.33 (± 0.99)	0.09 (± 0.09)	0.16 (± 0.21)	0.03 (± 0.02)
Cumulative impacts - Centralised mgmt.	0.16 (± 0.05)	8.18 (± 5.62)	4.34 (± 3.3)	3.87 (± 6.6)	1.35 (± 1.01)	0.12 (± 0.14)	0.01 (± 0.01)	0.03 (± 0.02)
Cumulative impacts - FewMPA	0.05 (± 0.08)	10.37 (± 7.11)	66.63 (± 62.58)	2.59 (± 4.44)	0.74 (± 0.56)	0.06 (± 0.09)	0.01 (± 0.01)	0.04 (± 0.03)
Cumulative impacts - Fragmented mgmt	0.21 (± 0.09)	8.2 (± 5.64)	4.53 (± 3.59)	3.35 (± 5.72)	1.35 (± 1.01)	0.11 (± 0.12)	0.01 (± 0.01)	0.03 (± 0.02)
Cumulative impacts - ManyMPA	0.01 (± 0.02)	9.25 (± 6.45)	22.9 (± 21.96)	0.01 (± 0.02)	1.43 (± 1.08)	0.04 (± 0.06)	0.01 (± 0.01)	0.31 (± 0.26)
Cumulative impacts - Seasons	0.12 (± 0.13)	40.22 (± 27.69)	300.39 (± 249.67)	4.97 (± 8.5)	0.42 (± 0.34)	0.08 (± 0.11)	0.07 (± 0.06)	0.02 (± 0.02)
Cumulative impacts - SlowAssess	0.08 (± 0.05)	10.35 (± 7.14)	4.31 (± 2.78)	3.75 (± 6.41)	1.39 (± 1.07)	0.11 (± 0.15)	0.07 (± 0.12)	0.03 (± 0.02)
Cumulative impacts - IM	0.2 (± 0.09)	8.2 (± 5.66)	4.61 (± 3.14)	3.69 (± 6.31)	1.33 (± 0.99)	0.09 (± 0.09)	0.16 (± 0.21)	0.03 (± 0.02)
Expanded LTL fishery - IM	1.36 (± 0.2)	8.29 (± 5.72)	1.28 (± 0.8)	9.75 (± 16.67)	1.33 (± 1)	0.23 (± 0.17)	12.75 (± 18.35)	0.16 (± 0.14)
New mesopelgic fishery - IM	0.92 (± 0.72)	10.3 (± 7)	2.32 (± 1.89)	11.94 (± 20.45)	1.03 (± 0.77)	0.05 (± 0.03)	11.65 (± 13.15)	0.09 (± 0.08)
Extreme climate events - IM	0.64 (± 0.6)	10.79 (± 7.6)	2.7 (± 1.61)	10.81 (± 18.51)	0.99 (± 0.74)	0.05 (± 0.03)	1.03 (± 1.26)	0.07 (± 0.06)
Blooms - IM	0.44 (± 0.35)	11.34 (± 7.68)	3 (± 2.22)	10.31 (± 17.61)	0.91 (± 0.65)	0.04 (± 0.03)	3.29 (± 4.57)	0.07 (± 0.06)
Primary production regime shift - IM	1.21 (± 0.84)	11.04 (± 6.65)	2.45 (± 1.79)	23.73 (± 40.85)	0.97 (± 0.72)	0.05 (± 0.02)	9.7 (± 15.58)	0.52 (± 0.83)
Fish kills - IM	0.56 (± 0.66)	11.34 (± 8.02)	2.65 (± 1.68)	10.61 (± 18.14)	0.93 (± 0.7)	0.05 (± 0.04)	1.65 (± 1.95)	0.07 (± 0.06)
Range extensions - IM	1.37 (± 0.66)	8.71 (± 6)	1.15 (± 0.48)	8.91 (± 15.17)	1.27 (± 0.97)	0.18 (± 0.14)	8.91 (± 13.5)	0.16 (± 0.08)
Gear switching allowed - IM	1.26 (± 0.82)	8.65 (± 6.07)	7.4 (± 10.53)	8.69 (± 14.85)	0.69 (± 0.52)	0.55 (± 0.63)	74.62 (± 93.51)	0.18 (± 0.15)
High compliance - IM	2.43 (± 2.45)	8.29 (± 5.71)	1.57 (± 0.72)	10.79 (± 18.48)	1.29 (± 0.96)	0.23 (± 0.03)	2 (± 1.72)	0.14 (± 0.13)
Low Compliance - IM	1.36 (± 1.09)	9.04 (± 6.23)	1.95 (± 1.57)	9.19 (± 15.71)	1.35 (± 1.01)	0.35 (± 0.4)	2.77 (± 3.97)	0.14 (± 0.12)
Flexible fisher behaviour - IM	2.35 (± 2.12)	9.76 (± 6.75)	1.87 (± 1.3)	9.44 (± 16.12)	2.65 (± 1.98)	0.22 (± 0.05)	13.15 (± 19.64)	0.42 (± 0.36)
Increased fishing pressure drivers - IM	2.26 (± 1.87)	8.35 (± 5.77)	1.39 (± 0.74)	8.92 (± 15.26)	1.24 (± 0.92)	0.2 (± 0.07)	3.45 (± 4.64)	0.13 (± 0.11)
High Cost, Low Values - IM	0.33 (± 0.13)	9.75 (± 6.65)	16.66 (± 11.19)	7.13 (± 12.22)	0.72 (± 0.55)	0.28 (± 0.33)	64.1 (± 80.87)	0.19 (± 0.16)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
Low Costs, High Values - IM	2.61 (± 2.87)	8.37 (± 5.78)	1.33 (± 0.81)	10.57 (± 18.1)	1.25 (± 0.93)	0.24 (± 0.13)	136.18 (± 221.09)	0.14 (± 0.12)
Standard Markets - IM	1.3 (± 0.79)	8.33 (± 5.74)	1.22 (± 0.71)	8.29 (± 14.15)	1.29 (± 0.97)	0.23 (± 0.14)	9.38 (± 8)	0.15 (± 0.13)
Technology Creep - IM	1.44 (± 0.79)	11.07 (± 7.62)	1.34 (± 0.83)	15.02 (± 25.65)	2.06 (± 1.57)	0.42 (± 0.49)	88.22 (± 132.66)	0.33 (± 0.28)
No Acclimation - 2010 coastal context - IM	0.05 (± 0.04)	445.98 (± 308.33)	1.29 (± 0.68)	8.52 (± 14.57)	0.02 (± 0.01)	1.75 (± 0.62)	975.04 (± 1441.01)	0.18 (± 0.16)
No Acclimation - Cumulative impacts - SQ	0.02 (± 0.02)	438.79 (± 299.79)	1.51 (± 0.64)	7.88 (± 13.55)	0.02 (± 0.02)	1.75 (± 1.02)	303.33 (± 524.64)	0.15 (± 0.2)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
No Climate change - 2010 context - SQ	1.47 (± 0.11)	1.35 (± 0.21)	1.5 (± 0.51)	1.97 (± 1.05)	1.43 (± 0.17)
2010 coastal context - Cap ecosystem take	1.76 (± 0.38)	0.59 (± 0.5)	0.93 (± 0.5)	0.84 (± 0.51)	1.29 (± 0.13)
2010 coastal context - Centralised mgmt.	1.76 (± 0.38)	0.59 (± 0.5)	0.92 (± 0.47)	0.83 (± 0.48)	1.27 (± 0.31)
2010 coastal context - FewMPA	1.49 (± 0.32)	0.48 (± 0.41)	0.5 (± 0.18)	0.52 (± 0.34)	1.29 (± 0.18)
2010 coastal context - Fragmented mgmt	1.76 (± 0.38)	0.59 (± 0.5)	0.93 (± 0.51)	0.83 (± 0.49)	1.37 (± 0.14)
2010 coastal context - ManyMPA	1.86 (± 0.43)	1.21 (± 1.07)	0.37 (± 0.22)	0.23 (± 0.15)	0.12 (± 0.01)
2010 coastal context - Seasons	1.04 (± 0.22)	0.49 (± 0.41)	0.69 (± 0.36)	0.8 (± 0.5)	2.68 (± 0.38)
2010 coastal context - SlowAssess	2.21 (± 0.63)	1.67 (± 2.35)	0.93 (± 0.48)	1.12 (± 0.32)	1.33 (± 0.14)
2010 coastal context - Integrated Mgmt (IM)	1.76 (± 0.38)	0.59 (± 0.5)	0.93 (± 0.5)	0.84 (± 0.51)	1.29 (± 0.13)
Cumulative impacts - 2010 Status Quo (SQ)	1.64 (± 0.35)	0.51 (± 0.44)	0.77 (± 0.39)	0.63 (± 0.37)	0.12 (± 0.01)
Cumulative impacts - Cap ecosystem take	1.64 (± 0.35)	0.5 (± 0.44)	0.78 (± 0.38)	0.63 (± 0.38)	0.11 (± 0.01)
Cumulative impacts - Centralised mgmt.	1.64 (± 0.35)	0.51 (± 0.44)	0.77 (± 0.35)	0.62 (± 0.35)	0.1 (± 0.01)
Cumulative impacts - FewMPA	1.39 (± 0.3)	0.41 (± 0.36)	0.42 (± 0.13)	0.39 (± 0.25)	0.1 (± 0)
Cumulative impacts - Fragmented mgmt	1.64 (± 0.35)	0.5 (± 0.44)	0.78 (± 0.39)	0.63 (± 0.36)	0.11 (± 0.01)
Cumulative impacts - ManyMPA	1.73 (± 0.4)	1.03 (± 0.93)	0.31 (± 0.17)	0.17 (± 0.11)	0.01 (± 0)
Cumulative impacts - Seasons	0.97 (± 0.21)	0.42 (± 0.36)	0.58 (± 0.27)	0.6 (± 0.37)	0.22 (± 0.01)
Cumulative impacts - SlowAssess	2.06 (± 0.6)	1.45 (± 2.05)	0.78 (± 0.36)	0.86 (± 0.26)	0.11 (± 0.01)
Cumulative impacts - IM	1.64 (± 0.35)	0.5 (± 0.44)	0.78 (± 0.38)	0.63 (± 0.38)	0.11 (± 0.01)
Expanded LTL fishery - IM	1.76 (± 0.38)	0.59 (± 0.5)	0.93 (± 0.5)	0.85 (± 0.49)	1.39 (± 0.14)
New mesopelgic fishery - IM	1.97 (± 0.42)	0.85 (± 0.72)	1 (± 0.46)	1.04 (± 0.63)	1.88 (± 0.2)
Extreme climate events - IM	1.96 (± 0.42)	0.85 (± 0.72)	0.99 (± 0.48)	1.02 (± 0.67)	1.76 (± 0.23)
Blooms - IM	1.96 (± 0.42)	0.84 (± 0.72)	1.05 (± 0.6)	1.05 (± 0.66)	1.7 (± 0.21)
Primary production regime shift - IM	2.49 (± 0.84)	1.62 (± 1.42)	1.04 (± 0.58)	2.95 (± 3.91)	1.86 (± 0.29)
Fish kills - IM	1.97 (± 0.42)	0.85 (± 0.72)	1.01 (± 0.53)	1.03 (± 0.66)	1.85 (± 0.33)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
Range extensions - IM	2.21 (± 0.64)	1.67 (± 2.36)	0.94 (± 0.48)	1.12 (± 0.31)	1.35 (± 0.14)
Gear switching allowed - IM	1.65 (± 0.36)	0.57 (± 0.48)	0.84 (± 0.44)	0.84 (± 0.47)	2 (± 0.29)
High compliance - IM	1.76 (± 0.38)	0.59 (± 0.5)	0.96 (± 0.51)	0.85 (± 0.49)	1.27 (± 0.09)
Low Compliance - IM	1.75 (± 0.38)	0.58 (± 0.49)	0.96 (± 0.48)	0.9 (± 0.55)	1.22 (± 0.21)
Flexible fisher behaviour - IM	5.1 (± 1.1)	1.7 (± 1.45)	1.09 (± 0.56)	1.36 (± 0.8)	1.23 (± 0.26)
Increased fishing pressure drivers - IM	1.76 (± 0.38)	0.59 (± 0.5)	0.93 (± 0.5)	0.84 (± 0.51)	1.29 (± 0.13)
High Cost, Low Values - IM	1.54 (± 0.34)	0.53 (± 0.45)	0.58 (± 0.33)	0.66 (± 0.4)	1.81 (± 0.34)
Low Costs, High Values - IM	1.76 (± 0.38)	0.59 (± 0.5)	0.89 (± 0.48)	0.81 (± 0.49)	1.38 (± 0.14)
Standard Markets - IM	1.76 (± 0.38)	0.59 (± 0.51)	0.92 (± 0.52)	0.83 (± 0.49)	1.42 (± 0.1)
Technology Creep - IM	3.45 (± 0.74)	1.18 (± 1)	0.99 (± 0.54)	1.79 (± 1.01)	1.96 (± 0.1)
No Acclimation - 2010 coastal context - IM	0.4 (± 0.09)	8.06 (± 6.88)	1.49 (± 0.8)	15.53 (± 9.5)	2.24 (± 0.23)
No Acclimation - Cumulative impacts - SQ	0.39 (± 0.07)	8.01 (± 7.07)	1.32 (± 0.56)	14.17 (± 9.64)	1.65 (± 1.26)

Table A. 5: Mean relative landings (± s.e.) of each fished group in Atlantis-SE for each strategy-scenario combination under RCP 4.5. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics "Major fishery" is noted as there is no fishery initially.

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	0.88 (± 0.91)	55.46 (± 85.7)	1.19 (± 1.3)	0.42 (± 0.43)	0.4 (± 0.28)	31.22 (± 29.01)	2.9 (± 1.42)
2010 coastal context - Cap ecosystem take	1.73 (± 2.23)	25.91 (± 30.1)	0.28 (± 0.36)	1.75 (± 1.83)	0.19 (± 0.13)	11.5 (± 7.53)	1.83 (± 2.09)
2010 coastal context - Centralised mgmt.	1.73 (± 2.24)	25.76 (± 28.99)	0.28 (± 0.36)	9.96 (± 12.9)	0.38 (± 0.42)	7.47 (± 6.52)	2.45 (± 3.38)
2010 coastal context - FewMPA	1.75 (± 2.26)	15.34 (± 8.4)	0.16 (± 0.21)	727.74 (± 849.14)	45.96 (± 72.43)	30.55 (± 29.57)	7.07 (± 6.03)
2010 coastal context - Fragmented mgmt	1.73 (± 2.23)	31.86 (± 44.5)	0.28 (± 0.36)	11.13 (± 16.34)	0.66 (± 0.63)	7.9 (± 5.88)	3.44 (± 4.25)
2010 coastal context - ManyMPA	1.68 (± 2.16)	33.07 (± 22.13)	0.22 (± 0.28)	0 (± 0)	0 (± 0)	25.47 (± 23.6)	1.92 (± 2.65)
2010 coastal context - Seasons	1.16 (± 1.5)	5.58 (± 4.73)	0.2 (± 0.27)	112.9 (± 100.65)	54.44 (± 92.98)	47.79 (± 41.37)	25.19 (± 33.49)
2010 coastal context - SlowAssess	1.73 (± 2.22)	14.31 (± 9.19)	0.28 (± 0.36)	10.8 (± 13.34)	1.68 (± 2.42)	10.6 (± 8.09)	1.09 (± 0.88)
2010 coastal context - Integrated Mgmt (IM)	1.73 (± 2.23)	25.91 (± 30.1)	0.28 (± 0.36)	1.75 (± 1.83)	0.19 (± 0.13)	26.24 (± 18.44)	1.83 (± 2.09)
Cumulative impacts - 2010 Status Quo (SQ)	1.7 (± 2.18)	12.42 (± 7.8)	0.25 (± 0.34)	0 (± 0)	0 (± 0)	1.39 (± 0.87)	1.26 (± 1.76)
Cumulative impacts - Cap ecosystem take	1.69 (± 2.17)	18.52 (± 12.36)	0.25 (± 0.33)	0 (± 0)	0 (± 0)	0.93 (± 0.47)	0.81 (± 0.81)
Cumulative impacts - Centralised mgmt.	1.7 (± 2.17)	19.92 (± 16.2)	0.25 (± 0.34)	0 (± 0)	0 (± 0)	0.73 (± 0.68)	0.96 (± 1.34)
Cumulative impacts - FewMPA	1.71 (± 2.2)	16.47 (± 12.65)	0.15 (± 0.2)	0 (± 0)	0 (± 0)	2.31 (± 1.71)	1.68 (± 2.13)
Cumulative impacts - Fragmented mgmt	1.69 (± 2.17)	16.96 (± 10.35)	0.25 (± 0.34)	0 (± 0)	0 (± 0)	0.62 (± 0.32)	1.42 (± 1.66)

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
Cumulative impacts - ManyMPA	1.65 (± 2.1)	38.41 (± 41.06)	0.2 (± 0.27)	0 (± 0)	0 (± 0)	1.94 (± 1.36)	0.7 (± 1.08)
Cumulative impacts - Seasons	1.13 (± 1.46)	5.56 (± 5.39)	0.18 (± 0.25)	0 (± 0)	0 (± 0)	3.65 (± 2.3)	3.13 (± 2.56)
Cumulative impacts - SlowAssess	1.69 (± 2.16)	17 (± 18.37)	0.26 (± 0.34)	0 (± 0)	0 (± 0)	0.85 (± 0.51)	0.43 (± 0.36)
Cumulative impacts - IM	1.69 (± 2.17)	18.52 (± 12.36)	0.25 (± 0.33)	0 (± 0)	0 (± 0)	2.54 (± 2.42)	0.81 (± 0.81)
Expanded LTL fishery - IM	1.73 (± 2.23)	24.96 (± 24.33)	0.27 (± 0.35)	34.51 (± 42.7)	1.75 (± 1.66)	2.11 (± 3.66)	3.83 (± 4.93)
New mesopelgic fishery - IM	1.88 (± 2.42)	49.37 (± 63.73)	0.66 (± 0.89)	5.71 (± 9.08)	0.48 (± 0.36)	2.63 (± 3.53)	24.6 (± 35.18)
Extreme climate events - IM	1.88 (± 2.43)	50.58 (± 65.82)	0.64 (± 0.86)	0.01 (± 0.01)	0.02 (± 0.02)	8 (± 5.16)	13.43 (± 10.82)
Blooms - IM	1.87 (± 2.4)	51.64 (± 66.11)	0.65 (± 0.87)	0.01 (± 0.01)	0.04 (± 0.06)	19.99 (± 15.97)	10.2 (± 11.21)
Primary production regime shift - IM	1.94 (± 2.53)	50.94 (± 65.65)	0.64 (± 0.86)	46.14 (± 79.9)	0.38 (± 0.63)	9.71 (± 6.92)	11.58 (± 7.23)
Fish kills - IM	1.88 (± 2.43)	48.41 (± 63.51)	0.64 (± 0.86)	0.02 (± 0.01)	0.03 (± 0.03)	8.26 (± 9.45)	5.58 (± 1.62)
Range extensions - IM	1.73 (± 2.23)	11.89 (± 7.4)	0.28 (± 0.36)	9.87 (± 5.89)	26.98 (± 43.85)	11.48 (± 10.29)	3.96 (± 4.84)
Gear switching allowed - IM	1.72 (± 2.22)	13.69 (± 9.81)	0.16 (± 0.21)	221.49 (± 368.5)	13.72 (± 15.85)	24.06 (± 31.22)	1.18 (± 1.29)
High compliance - IM	1.74 (± 2.24)	18.06 (± 11.51)	0.27 (± 0.35)	14.89 (± 25.25)	0.43 (± 0.19)	6.58 (± 6.2)	2.37 (± 2.09)
Low Compliance - IM	1.73 (± 2.23)	15.85 (± 13.5)	0.29 (± 0.37)	1.31 (± 1.39)	0.28 (± 0.45)	18.76 (± 16.99)	3.82 (± 5.63)
Flexible fisher behaviour - IM	4.79 (± 6.17)	22.23 (± 20.87)	0.73 (± 0.93)	15.96 (± 15.57)	1.14 (± 1.46)	3.36 (± 5.82)	2.96 (± 3.56)
Increased fishing pressure drivers - IM	1.73 (± 2.23)	25.91 (± 30.1)	0.28 (± 0.36)	1.75 (± 1.83)	0.19 (± 0.13)	17.87 (± 16.54)	1.83 (± 2.09)
High Cost, Low Values - IM	1.75 (± 2.26)	28.48 (± 28.94)	0.16 (± 0.21)	586.59 (± 510.02)	85.06 (± 98.51)	30.17 (± 28.64)	17.56 (± 16.57)
Low Costs, High Values - IM	1.73 (± 2.22)	31.65 (± 42.9)	0.28 (± 0.36)	10.05 (± 15.64)	0.18 (± 0.09)	2.43 (± 3.27)	1.32 (± 1.23)
Standard Markets - IM	1.74 (± 2.24)	18.44 (± 22.38)	0.28 (± 0.36)	9.24 (± 13.06)	0.75 (± 0.61)	18.06 (± 15.37)	3.45 (± 4.29)
Technology Creep - IM	3.31 (± 4.27)	31.39 (± 18.11)	0.46 (± 0.59)	221.44 (± 197.19)	7.54 (± 5.52)	8.35 (± 14.24)	3.15 (± 3.48)
No Acclimation - 2010 coastal context - IM	0 (± 0)	0 (± 0)	0 (± 0)	31.65 (± 27.75)	206.42 (± 356.39)	2.96 (± 2.08)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0 (± 0)	0 (± 0)	0 (± 0)	0 (± 0)	1.81 (± 2.01)	0 (± 0)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	0.03 (± 0.02)	1.23 (± 0.45)	0 (± 0)	0 (± 0)	0.71 (± 0.74)	0.15 (± 0.09)	0.83 (± 0.43)	2.3 (± 3.41)
2010 coastal context - Cap ecosystem take	0.02 (± 0.02)	0.91 (± 0.96)	0 (± 0)	0 (± 0)	0.16 (± 0.14)	0.38 (± 0.4)	0.32 (± 0.2)	0.85 (± 1.18)
2010 coastal context - Centralised mgmt.	0.02 (± 0.02)	0.68 (± 0.64)	0 (± 0)	0 (± 0)	0.15 (± 0.14)	0.28 (± 0.17)	0.35 (± 0.35)	1.99 (± 1.54)
2010 coastal context - FewMPA	0.02 (± 0.02)	0.99 (± 0.86)	0 (± 0)	0 (± 0)	0.13 (± 0.11)	0.62 (± 0.27)	0.46 (± 0.75)	34.97 (± 32.66)
2010 coastal context - Fragmented mgmt	0.02 (± 0.02)	0.85 (± 0.89)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.48 (± 0.46)	0.46 (± 0.51)	1.37 (± 1.7)
2010 coastal context - ManyMPA	0.02 (± 0.02)	0.67 (± 0.66)	0 (± 0)	0 (± 0)	0.13 (± 0.14)	0.01 (± 0.01)	1.76 (± 2.31)	0 (± 0)
2010 coastal context - Seasons	0 (± 0)	0.67 (± 0.61)	0 (± 0)	0 (± 0)	0.16 (± 0.15)	0.14 (± 0.04)	0.47 (± 0.69)	24.06 (± 22.66)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
2010 coastal context - SlowAssess	0.02 (± 0.02)	0.59 (± 0.6)	0 (± 0)	0 (± 0)	0.15 (± 0.14)	0.36 (± 0.22)	0.16 (± 0.16)	11.91 (± 19.3)
2010 coastal context - Integrated Mgmt (IM)	0.02 (± 0.02)	0.91 (± 0.96)	0 (± 0)	0 (± 0)	0.16 (± 0.14)	0.38 (± 0.4)	0.32 (± 0.2)	0.85 (± 1.18)
Cumulative impacts - 2010 Status Quo (SQ)	0.02 (± 0.02)	0.73 (± 0.93)	0 (± 0)	0 (± 0)	0.17 (± 0.16)	0.06 (± 0.09)	0.19 (± 0.27)	0 (± 0)
Cumulative impacts - Cap ecosystem take	0.02 (± 0.02)	0.76 (± 0.98)	0 (± 0)	0 (± 0)	0.18 (± 0.16)	0.1 (± 0.16)	0.12 (± 0.12)	0 (± 0)
Cumulative impacts - Centralised mgmt.	0.02 (± 0.02)	0.55 (± 0.64)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.06 (± 0.09)	0.15 (± 0.19)	0 (± 0)
Cumulative impacts - FewMPA	0.02 (± 0.02)	0.77 (± 0.82)	0 (± 0)	0 (± 0)	0.14 (± 0.12)	0.1 (± 0.14)	0.22 (± 0.37)	0 (± 0)
Cumulative impacts - Fragmented mgmt	0.02 (± 0.02)	0.71 (± 0.91)	0 (± 0)	0 (± 0)	0.19 (± 0.16)	0.12 (± 0.19)	0.2 (± 0.26)	0 (± 0)
Cumulative impacts - ManyMPA	0.02 (± 0.02)	0.44 (± 0.38)	0 (± 0)	0 (± 0)	0.15 (± 0.14)	0 (± 0)	0.79 (± 1.17)	0 (± 0)
Cumulative impacts - Seasons	0 (± 0)	0.46 (± 0.39)	0 (± 0)	0 (± 0)	0.18 (± 0.16)	0.02 (± 0.03)	0.21 (± 0.34)	0 (± 0)
Cumulative impacts - SlowAssess	0.02 (± 0.02)	0.49 (± 0.61)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.07 (± 0.11)	0.07 (± 0.09)	0 (± 0)
Cumulative impacts - IM	0.02 (± 0.02)	0.76 (± 0.98)	0 (± 0)	0 (± 0)	0.18 (± 0.16)	0.1 (± 0.16)	0.12 (± 0.12)	0 (± 0)
Expanded LTL fishery - IM	0.02 (± 0.02)	0.97 (± 0.86)	0 (± 0)	0 (± 0)	0.17 (± 0.15)	0.48 (± 0.28)	0.36 (± 0.38)	4.97 (± 4.15)
New mesopelgic fishery - IM	0 (± 0)	0.84 (± 0.72)	Major fishery	Major fishery	0.28 (± 0.26)	0.13 (± 0.11)	0.24 (± 0.36)	2.18 (± 1.63)
Extreme climate events - IM	0 (± 0)	0.78 (± 0.87)	0 (± 0)	0 (± 0)	0.29 (± 0.25)	0.08 (± 0.11)	0.15 (± 0.21)	0.05 (± 0.07)
Blooms - IM	0 (± 0)	0.66 (± 0.69)	0 (± 0)	0 (± 0)	0.28 (± 0.25)	0.09 (± 0.12)	0.11 (± 0.16)	0.07 (± 0.13)
Primary production regime shift - IM	0 (± 0)	0.76 (± 0.87)	0 (± 0)	0 (± 0)	0.29 (± 0.26)	0.15 (± 0.14)	0.16 (± 0.13)	6.35 (± 10.92)
Fish kills - IM	0 (± 0)	0.66 (± 0.85)	0 (± 0)	0 (± 0)	0.29 (± 0.26)	0.08 (± 0.12)	0.07 (± 0.08)	0.06 (± 0.09)
Range extensions - IM	0.02 (± 0.02)	0.97 (± 1)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.31 (± 0.22)	0.41 (± 0.42)	20.59 (± 35.04)
Gear switching allowed - IM	0.02 (± 0.02)	1 (± 0.97)	0 (± 0)	0 (± 0)	0.13 (± 0.12)	0.23 (± 0.09)	0.57 (± 0.78)	17.37 (± 14.44)
High compliance - IM	0.02 (± 0.02)	0.49 (± 0.47)	0 (± 0)	0 (± 0)	0.16 (± 0.15)	0.41 (± 0.46)	0.35 (± 0.24)	2.94 (± 2.52)
Low Compliance - IM	0.02 (± 0.02)	0.51 (± 0.46)	0 (± 0)	0 (± 0)	0.15 (± 0.13)	0.28 (± 0.23)	0.59 (± 0.87)	0.06 (± 0.08)
Flexible fisher behaviour - IM	0.06 (± 0.05)	0.75 (± 0.63)	0 (± 0)	0 (± 0)	0.3 (± 0.29)	0.36 (± 0.23)	0.35 (± 0.22)	3.8 (± 2.52)
Increased fishing pressure drivers - IM	0.02 (± 0.02)	0.91 (± 0.96)	0 (± 0)	0 (± 0)	0.16 (± 0.14)	0.38 (± 0.4)	0.32 (± 0.2)	0.85 (± 1.18)
High Cost, Low Values - IM	0.02 (± 0.02)	0.98 (± 0.83)	0 (± 0)	0 (± 0)	0.17 (± 0.2)	0.52 (± 0.14)	0.29 (± 0.36)	40.23 (± 47.82)
Low Costs, High Values - IM	0.02 (± 0.02)	0.79 (± 0.87)	0 (± 0)	0 (± 0)	0.16 (± 0.14)	0.38 (± 0.38)	0.36 (± 0.22)	1.39 (± 1.54)
Standard Markets - IM	0.02 (± 0.02)	0.87 (± 0.91)	0 (± 0)	0 (± 0)	0.15 (± 0.15)	0.32 (± 0.15)	0.43 (± 0.53)	1.51 (± 1.08)
Technology Creep - IM	0.04 (± 0.04)	0.92 (± 0.94)	0 (± 0)	0 (± 0)	0.24 (± 0.24)	0.42 (± 0.19)	0.53 (± 0.74)	22.19 (± 19.86)
No Acclimation - 2010 coastal context - IM	0 (± 0)	0.29 (± 0.3)	0 (± 0)	0 (± 0)	0 (± 0)	5.59 (± 5.98)	1.41 (± 0.88)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0.23 (± 0.3)	0 (± 0)	0 (± 0)	0 (± 0)	3.4 (± 3.49)	1.08 (± 0.98)	0 (± 0)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	0.6 (± 0.1)	1.39 (± 0.9)	4.23 (± 4.95)	2.01 (± 2.16)	0.36 (± 0.5)	1.79 (± 1.46)	1.98 (± 1.23)	1.73 (± 0.07)
2010 coastal context - Cap ecosystem take	0.31 (± 0.36)	0.98 (± 0.79)	0.32 (± 0.4)	0.49 (± 0.24)	0.49 (± 0.71)	0.65 (± 0.36)	3.44 (± 2.74)	2.21 (± 1.17)
2010 coastal context - Centralised mgmt.	0.2 (± 0.22)	1.25 (± 1.09)	0.22 (± 0.34)	0.48 (± 0.33)	0.35 (± 0.4)	0.69 (± 0.08)	2.8 (± 1.92)	1.59 (± 0.2)
2010 coastal context - FewMPA	0.11 (± 0.05)	3.91 (± 4.8)	0.35 (± 0.54)	0.69 (± 0.57)	0.79 (± 0.67)	0.32 (± 0.38)	0 (± 0)	2.25 (± 1.71)
2010 coastal context - Fragmented mgmt	0.02 (± 0.03)	1.78 (± 1.59)	0.15 (± 0.15)	0.59 (± 0.48)	0.64 (± 0.89)	0.72 (± 0.44)	3.07 (± 1.48)	1.71 (± 0.59)
2010 coastal context - ManyMPA	0.22 (± 0.17)	0.22 (± 0.34)	1.09 (± 1.53)	0.59 (± 0.99)	0.15 (± 0.25)	2.39 (± 2.56)	0.55 (± 0.46)	2.2 (± 1.42)
2010 coastal context - Seasons	0.05 (± 0.04)	1.8 (± 2.29)	0.73 (± 1.15)	1.38 (± 0.93)	0.29 (± 0.48)	2.68 (± 2.82)	0 (± 0)	4.01 (± 2.46)
2010 coastal context - SlowAssess	0.08 (± 0.06)	1.26 (± 1.05)	0.18 (± 0.24)	1.04 (± 0.99)	0.42 (± 0.51)	0.42 (± 0.19)	2.58 (± 2.3)	1.05 (± 0.49)
2010 coastal context - Integrated Mgmt (IM)	0.31 (± 0.36)	0.98 (± 0.79)	0.32 (± 0.4)	0.49 (± 0.24)	0.49 (± 0.71)	0.65 (± 0.36)	3.44 (± 2.74)	2.21 (± 1.17)
Cumulative impacts - 2010 Status Quo (SQ)	0.22 (± 0.33)	0.36 (± 0.49)	0.11 (± 0.14)	0.64 (± 0.34)	0.2 (± 0.34)	0.19 (± 0.2)	2.64 (± 1.64)	0.61 (± 0.39)
Cumulative impacts - Cap ecosystem take	66.31 (± 114.8)	0.25 (± 0.23)	0.25 (± 0.38)	0.49 (± 0.31)	0.37 (± 0.64)	0.24 (± 0.2)	3.4 (± 3.25)	0.92 (± 0.7)
Cumulative impacts - Centralised mgmt.	40.72 (± 70.49)	0.26 (± 0.32)	0.19 (± 0.31)	0.4 (± 0.14)	0.23 (± 0.4)	0.29 (± 0.22)	2.69 (± 2.19)	0.67 (± 0.45)
Cumulative impacts - FewMPA	14.57 (± 25.19)	0.34 (± 0.27)	0.3 (± 0.49)	1.02 (± 1.33)	0.43 (± 0.72)	0.23 (± 0.33)	0 (± 0)	1.31 (± 1.48)
Cumulative impacts - Fragmented mgmt	0.21 (± 0.34)	0.41 (± 0.46)	0.11 (± 0.14)	0.51 (± 0.27)	0.47 (± 0.81)	0.33 (± 0.27)	2.87 (± 1.5)	0.72 (± 0.5)
Cumulative impacts - ManyMPA	34.22 (± 59.17)	0.07 (± 0.09)	0.9 (± 1.42)	0.35 (± 0.54)	0.12 (± 0.21)	1.66 (± 2.28)	0.48 (± 0.36)	1.22 (± 1.17)
Cumulative impacts - Seasons	8.57 (± 14.83)	0.13 (± 0.13)	0.63 (± 1.05)	1.91 (± 2.29)	0.24 (± 0.41)	1.84 (± 2.52)	0 (± 0)	2.2 (± 2.12)
Cumulative impacts - SlowAssess	13.1 (± 22.65)	0.21 (± 0.21)	0.15 (± 0.23)	1.79 (± 2.63)	0.28 (± 0.49)	0.22 (± 0.26)	2.47 (± 2.54)	0.55 (± 0.53)
Cumulative impacts - IM	66.31 (± 114.8)	0.25 (± 0.23)	0.25 (± 0.38)	0.49 (± 0.31)	0.37 (± 0.64)	0.24 (± 0.2)	3.4 (± 3.25)	0.92 (± 0.7)
Expanded LTL fishery - IM	0.19 (± 0.2)	2.15 (± 1.96)	0.16 (± 0.24)	0.54 (± 0.38)	0.55 (± 0.62)	0.74 (± 0.06)	2.09 (± 1.37)	1.4 (± 0.23)
New mesopelgic fishery - IM	0.11 (± 0.14)	1.03 (± 0.93)	0.36 (± 0.58)	1.08 (± 1.5)	0.08 (± 0.1)	0.83 (± 0.98)	25.04 (± 16.22)	2.62 (± 1.15)
Extreme climate events - IM	0.16 (± 0.21)	0.4 (± 0.33)	0.61 (± 0.97)	0.73 (± 0.86)	0.06 (± 0.09)	0.46 (± 0.38)	25.46 (± 13.89)	2.81 (± 0.52)
Blooms - IM	0.15 (± 0.2)	0.36 (± 0.34)	0.54 (± 0.84)	0.77 (± 0.99)	0.06 (± 0.1)	0.31 (± 0.23)	31.88 (± 17.22)	1.78 (± 0.48)
Primary production regime shift - IM	0.21 (± 0.26)	0.84 (± 0.89)	0.59 (± 0.93)	1.48 (± 1.04)	0.09 (± 0.12)	1.19 (± 0.97)	14.33 (± 9.45)	2.69 (± 0.74)
Fish kills - IM	0.06 (± 0.06)	0.25 (± 0.2)	0.65 (± 1.02)	0.66 (± 0.85)	0.06 (± 0.09)	0.54 (± 0.43)	35.36 (± 28.28)	2.19 (± 0.69)
Range extensions - IM	0.3 (± 0.23)	1.56 (± 1.31)	0.25 (± 0.34)	1.17 (± 0.94)	0.5 (± 0.66)	0.47 (± 0.21)	3.22 (± 2.92)	1.4 (± 0.83)
Gear switching allowed - IM	0.22 (± 0.22)	1.38 (± 1.33)	0.04 (± 0.03)	1.1 (± 0.99)	0.22 (± 0.19)	1.49 (± 1.6)	0.11 (± 0.05)	1.34 (± 0.88)
High compliance - IM	0.22 (± 0.23)	1.11 (± 1.04)	0.27 (± 0.43)	0.48 (± 0.22)	0.53 (± 0.72)	1.17 (± 0.97)	2.57 (± 1.76)	2.32 (± 1.59)
Low Compliance - IM	0.09 (± 0.06)	1.48 (± 1.42)	0.04 (± 0.03)	0.56 (± 0.26)	0.35 (± 0.45)	1.97 (± 2.58)	3.39 (± 2.88)	2.2 (± 1.35)
Flexible fisher behaviour - IM	0.3 (± 0.35)	1.52 (± 1.29)	0.27 (± 0.43)	0.55 (± 0.23)	0.43 (± 0.49)	0.96 (± 0.84)	2.74 (± 2.09)	2.24 (± 1.74)
Increased fishing pressure drivers - IM	0.31 (± 0.36)	0.98 (± 0.79)	0.32 (± 0.4)	0.49 (± 0.24)	0.49 (± 0.71)	0.65 (± 0.36)	3.44 (± 2.74)	2.21 (± 1.17)
High Cost, Low Values - IM	0.18 (± 0.2)	5.46 (± 4.75)	0.09 (± 0.1)	0.69 (± 0.62)	0.49 (± 0.25)	0.73 (± 0.76)	0 (± 0)	2.32 (± 1.46)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
Low Costs, High Values - IM	0.19 (± 0.17)	0.99 (± 0.78)	1.84 (± 3.02)	0.49 (± 0.15)	0.51 (± 0.67)	0.99 (± 0.86)	2.77 (± 1.46)	2.25 (± 1.78)
Standard Markets - IM	0.05 (± 0.05)	1.86 (± 1.66)	0.15 (± 0.15)	0.69 (± 0.39)	0.3 (± 0.34)	0.55 (± 0.35)	2.85 (± 1.7)	1.53 (± 0.23)
Technology Creep - IM	0.34 (± 0.43)	2.17 (± 1.83)	0.32 (± 0.42)	0.52 (± 0.29)	0.5 (± 0.53)	1 (± 0.91)	0.79 (± 0.88)	1.83 (± 1.11)
No Acclimation - 2010 coastal context - IM	0.06 (± 0.07)	5.26 (± 4.26)	1.12 (± 1.41)	0.01 (± 0.01)	0.96 (± 1.38)	0 (± 0)	0.04 (± 0.03)	3.26 (± 1.73)
No Acclimation - Cumulative impacts - SQ	0.05 (± 0.06)	5.63 (± 5.61)	0.48 (± 0.47)	0.02 (± 0)	0.54 (± 0.72)	0 (± 0)	0.03 (± 0.02)	2.09 (± 0.61)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
No Climate change - 2010 context - SQ	0.77 (± 0.64)	9.83 (± 6.61)	1.23 (± 0.36)	0.74 (± 0.86)	1.56 (± 0.71)	0.2 (± 0.11)	5.51 (± 4.72)	0.19 (± 0.07)
2010 coastal context - Cap ecosystem take	2.37 (± 1.88)	8.45 (± 5.84)	1.49 (± 0.64)	8.99 (± 15.36)	1.27 (± 0.97)	0.13 (± 0.02)	5.05 (± 3.87)	0.13 (± 0.11)
2010 coastal context - Centralised mgmt.	1.56 (± 0.69)	8.44 (± 5.8)	1.39 (± 0.71)	9.42 (± 16.09)	1.29 (± 0.99)	0.15 (± 0.08)	7.71 (± 11)	0.14 (± 0.12)
2010 coastal context - FewMPA	0.25 (± 0.23)	10.7 (± 7.35)	20.68 (± 14.59)	6.3 (± 10.81)	0.71 (± 0.54)	0.06 (± 0.07)	55.31 (± 84.27)	0.19 (± 0.16)
2010 coastal context - Fragmented mgmt	2.01 (± 1.13)	8.45 (± 5.82)	1.44 (± 0.78)	8.16 (± 13.93)	1.29 (± 0.99)	0.14 (± 0.06)	7.08 (± 9.71)	0.14 (± 0.13)
2010 coastal context - ManyMPA	0.08 (± 0.05)	9.54 (± 6.66)	7.07 (± 5.2)	0.03 (± 0.06)	1.37 (± 1.05)	0.04 (± 0.04)	0.11 (± 0.09)	1.55 (± 1.31)
2010 coastal context - Seasons	0.79 (± 0.41)	41.48 (± 28.59)	94.69 (± 58.31)	12.1 (± 20.72)	0.4 (± 0.33)	0.08 (± 0.08)	81.99 (± 127.05)	0.1 (± 0.1)
2010 coastal context - SlowAssess	0.73 (± 0.2)	10.67 (± 7.38)	1.41 (± 0.54)	9.14 (± 15.61)	1.33 (± 1.04)	0.13 (± 0.1)	3.64 (± 4.27)	0.16 (± 0.1)
2010 coastal context - Integrated Mgmt (IM)	2.37 (± 1.88)	8.45 (± 5.84)	1.49 (± 0.64)	8.99 (± 15.36)	1.27 (± 0.97)	0.13 (± 0.02)	5.05 (± 3.87)	0.13 (± 0.11)
Cumulative impacts - 2010 Status Quo (SQ)	0.17 (± 0.12)	8.29 (± 5.7)	4.31 (± 2.7)	3.45 (± 5.89)	1.41 (± 1.09)	0.07 (± 0.07)	822.86 (± 1425.24)	0.03 (± 0.03)
Cumulative impacts - Cap ecosystem take	0.21 (± 0.09)	8.3 (± 5.72)	4.92 (± 2.86)	3.72 (± 6.35)	1.36 (± 1.04)	0.06 (± 0.05)	0.01 (± 0.02)	0.03 (± 0.02)
Cumulative impacts - Centralised mgmt.	0.17 (± 0.04)	8.29 (± 5.69)	4.59 (± 3.03)	3.9 (± 6.65)	1.38 (± 1.06)	0.08 (± 0.08)	0.01 (± 0.01)	0.03 (± 0.02)
Cumulative impacts - FewMPA	0.05 (± 0.07)	10.51 (± 7.22)	69.72 (± 58.68)	2.61 (± 4.47)	0.75 (± 0.58)	0.04 (± 0.05)	0.01 (± 0.01)	0.04 (± 0.03)
Cumulative impacts - Fragmented mgmt	0.21 (± 0.08)	8.3 (± 5.71)	4.8 (± 3.31)	3.38 (± 5.76)	1.38 (± 1.07)	0.07 (± 0.07)	0.01 (± 0.01)	0.03 (± 0.02)
Cumulative impacts - ManyMPA	0.01 (± 0.02)	9.37 (± 6.54)	24 (± 20.7)	0.01 (± 0.02)	1.46 (± 1.13)	0.03 (± 0.03)	0 (± 0.01)	0.31 (± 0.26)
Cumulative impacts - Seasons	0.12 (± 0.13)	40.76 (± 28.1)	319.53 (± 235.78)	5.01 (± 8.56)	0.43 (± 0.34)	0.05 (± 0.06)	0.02 (± 0.02)	0.02 (± 0.02)
Cumulative impacts - SlowAssess	0.09 (± 0.04)	10.49 (± 7.26)	4.6 (± 2.5)	3.78 (± 6.45)	1.42 (± 1.12)	0.07 (± 0.09)	0 (± 0)	0.03 (± 0.02)
Cumulative impacts - IM	0.21 (± 0.09)	8.3 (± 5.72)	4.92 (± 2.86)	3.72 (± 6.35)	1.36 (± 1.04)	0.06 (± 0.05)	0 (± 0)	0.03 (± 0.02)
Expanded LTL fishery - IM	1.42 (± 0.24)	8.4 (± 5.79)	1.36 (± 0.72)	9.82 (± 16.79)	1.36 (± 1.05)	0.15 (± 0.09)	12.36 (± 18.36)	0.16 (± 0.14)
New mesopelgic fishery - IM	1.01 (± 0.89)	10.43 (± 7.09)	2.45 (± 1.75)	12.03 (± 20.6)	1.05 (± 0.8)	0.03 (± 0.02)	11.06 (± 13.55)	0.08 (± 0.08)
Extreme climate events - IM	0.71 (± 0.74)	10.92 (± 7.68)	2.89 (± 1.44)	10.89 (± 18.64)	1.01 (± 0.77)	0.03 (± 0.02)	0.84 (± 1.38)	0.07 (± 0.06)
Blooms - IM	0.48 (± 0.42)	11.49 (± 7.82)	3.19 (± 2.05)	10.39 (± 17.74)	0.92 (± 0.68)	0.02 (± 0.02)	2.86 (± 4.82)	0.07 (± 0.06)
Primary production regime shift - IM	1.28 (± 0.87)	11.17 (± 6.74)	2.58 (± 1.62)	23.9 (± 41.15)	0.99 (± 0.75)	0.03 (± 0.01)	9.61 (± 15.76)	0.52 (± 0.83)
Fish kills - IM	0.63 (± 0.8)	11.47 (± 8.09)	2.83 (± 1.5)	10.69 (± 18.27)	0.94 (± 0.72)	0.03 (± 0.02)	1.49 (± 2.07)	0.07 (± 0.06)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
Range extensions - IM	1.43 (± 0.66)	8.83 (± 6.09)	1.25 (± 0.41)	8.97 (± 15.28)	1.29 (± 1.01)	0.12 (± 0.07)	8.56 (± 13.56)	0.16 (± 0.08)
Gear switching allowed - IM	1.27 (± 0.78)	8.77 (± 6.18)	7.46 (± 10.24)	8.76 (± 14.96)	0.7 (± 0.54)	0.35 (± 0.36)	64.36 (± 100.34)	0.18 (± 0.15)
High compliance - IM	2.54 (± 2.44)	8.39 (± 5.78)	1.68 (± 0.59)	10.87 (± 18.61)	1.31 (± 1.01)	0.16 (± 0.05)	1.98 (± 1.76)	0.14 (± 0.13)
Low Compliance - IM	1.38 (± 1.07)	9.16 (± 6.33)	2.04 (± 1.44)	9.26 (± 15.82)	1.38 (± 1.07)	0.23 (± 0.23)	2.66 (± 3.99)	0.14 (± 0.12)
Flexible fisher behaviour - IM	2.44 (± 2.1)	9.88 (± 6.82)	1.98 (± 1.18)	9.51 (± 16.24)	2.7 (± 2.08)	0.15 (± 0.04)	12.75 (± 19.63)	0.42 (± 0.36)
Increased fishing pressure drivers - IM	2.37 (± 1.88)	8.45 (± 5.84)	1.49 (± 0.64)	8.99 (± 15.36)	1.27 (± 0.97)	0.13 (± 0.02)	3.23 (± 4.76)	0.13 (± 0.11)
High Cost, Low Values - IM	0.33 (± 0.11)	9.88 (± 6.75)	17.76 (± 10.13)	7.18 (± 12.31)	0.73 (± 0.57)	0.18 (± 0.19)	55.49 (± 86.58)	0.18 (± 0.16)
Low Costs, High Values - IM	2.69 (± 2.85)	8.47 (± 5.84)	1.42 (± 0.72)	10.65 (± 18.23)	1.27 (± 0.98)	0.16 (± 0.08)	5.66 (± 7.46)	0.14 (± 0.12)
Standard Markets - IM	1.41 (± 1.01)	8.44 (± 5.81)	1.31 (± 0.62)	8.35 (± 14.25)	1.32 (± 1.02)	0.14 (± 0.07)	7.07 (± 9.71)	0.15 (± 0.13)
Technology Creep - IM	1.44 (± 0.69)	11.21 (± 7.72)	1.44 (± 0.74)	15.14 (± 25.83)	2.1 (± 1.64)	0.27 (± 0.28)	85.46 (± 132.66)	0.33 (± 0.28)
No Acclimation - 2010 coastal context - IM	0.05 (± 0.04)	451.6 (± 311.73)	1.38 (± 0.59)	8.59 (± 14.68)	0.02 (± 0.01)	1.16 (± 0.2)	964.71 (± 1422.24)	0.18 (± 0.16)
No Acclimation - Cumulative impacts - SQ	0.02 (± 0.02)	444.47 (± 303.71)	1.62 (± 0.58)	7.94 (± 13.64)	0.02 (± 0.02)	1.09 (± 0.44)	304.57 (± 526.79)	0.15 (± 0.2)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
No Climate change - 2010 context - SQ	1.47 (± 0.11)	1.35 (± 0.21)	1.5 (± 0.51)	1.97 (± 1.05)	1.43 (± 0.17)
2010 coastal context - Cap ecosystem take	1.73 (± 0.37)	0.58 (± 0.49)	0.98 (± 0.6)	0.85 (± 0.51)	1.35 (± 0.16)
2010 coastal context - Centralised mgmt.	1.74 (± 0.37)	0.58 (± 0.49)	0.97 (± 0.57)	0.84 (± 0.48)	1.33 (± 0.35)
2010 coastal context - FewMPA	1.48 (± 0.31)	0.48 (± 0.4)	0.52 (± 0.23)	0.52 (± 0.34)	1.35 (± 0.23)
2010 coastal context - Fragmented mgmt	1.73 (± 0.37)	0.58 (± 0.49)	0.98 (± 0.62)	0.85 (± 0.49)	1.43 (± 0.16)
2010 coastal context - ManyMPA	1.84 (± 0.42)	1.19 (± 1.05)	0.39 (± 0.26)	0.23 (± 0.15)	0.12 (± 0.01)
2010 coastal context - Seasons	1.02 (± 0.22)	0.48 (± 0.41)	0.72 (± 0.43)	0.81 (± 0.5)	2.8 (± 0.43)
2010 coastal context - SlowAssess	2.18 (± 0.61)	1.64 (± 2.3)	0.98 (± 0.58)	1.13 (± 0.28)	1.39 (± 0.19)
2010 coastal context - Integrated Mgmt (IM)	1.73 (± 0.37)	0.58 (± 0.49)	0.98 (± 0.6)	0.85 (± 0.51)	1.35 (± 0.16)
Cumulative impacts - 2010 Status Quo (SQ)	1.62 (± 0.34)	0.5 (± 0.43)	0.81 (± 0.47)	0.64 (± 0.37)	0.12 (± 0.01)
Cumulative impacts - Cap ecosystem take	1.61 (± 0.34)	0.5 (± 0.43)	0.82 (± 0.46)	0.64 (± 0.38)	0.11 (± 0)
Cumulative impacts - Centralised mgmt.	1.62 (± 0.34)	0.5 (± 0.43)	0.81 (± 0.43)	0.63 (± 0.35)	0.11 (± 0.01)
Cumulative impacts - FewMPA	1.37 (± 0.29)	0.41 (± 0.35)	0.44 (± 0.17)	0.4 (± 0.25)	0.11 (± 0)
Cumulative impacts - Fragmented mgmt	1.61 (± 0.34)	0.5 (± 0.43)	0.82 (± 0.47)	0.64 (± 0.36)	0.12 (± 0.01)
Cumulative impacts - ManyMPA	1.71 (± 0.39)	1.02 (± 0.92)	0.33 (± 0.2)	0.17 (± 0.11)	0.01 (± 0)
Cumulative impacts - Seasons	0.95 (± 0.2)	0.41 (± 0.35)	0.6 (± 0.33)	0.61 (± 0.37)	0.23 (± 0)
Cumulative impacts - SlowAssess	2.03 (± 0.57)	1.42 (± 2.01)	0.82 (± 0.44)	0.86 (± 0.23)	0.11 (± 0)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
Cumulative impacts - IM	1.61 (± 0.34)	0.5 (± 0.43)	0.82 (± 0.46)	0.64 (± 0.38)	0.11 (± 0)
Expanded LTL fishery - IM	1.74 (± 0.37)	0.58 (± 0.49)	0.98 (± 0.6)	0.86 (± 0.49)	1.45 (± 0.15)
New mesopelgic fishery - IM	1.94 (± 0.41)	0.84 (± 0.71)	1.06 (± 0.56)	1.06 (± 0.63)	1.96 (± 0.22)
Extreme climate events - IM	1.94 (± 0.41)	0.83 (± 0.71)	1.04 (± 0.58)	1.04 (± 0.67)	1.83 (± 0.21)
Blooms - IM	1.94 (± 0.41)	0.83 (± 0.7)	1.11 (± 0.72)	1.07 (± 0.66)	1.78 (± 0.22)
Primary production regime shift - IM	2.46 (± 0.85)	1.61 (± 1.43)	1.1 (± 0.7)	2.96 (± 3.9)	1.95 (± 0.41)
Fish kills - IM	1.94 (± 0.41)	0.83 (± 0.71)	1.07 (± 0.63)	1.04 (± 0.66)	1.93 (± 0.33)
Range extensions - IM	2.18 (± 0.61)	1.65 (± 2.31)	0.99 (± 0.58)	1.13 (± 0.28)	1.41 (± 0.14)
Gear switching allowed - IM	1.63 (± 0.35)	0.56 (± 0.48)	0.88 (± 0.53)	0.85 (± 0.47)	2.08 (± 0.28)
High compliance - IM	1.73 (± 0.36)	0.58 (± 0.49)	1.01 (± 0.62)	0.86 (± 0.49)	1.33 (± 0.15)
Low Compliance - IM	1.73 (± 0.37)	0.57 (± 0.48)	1.01 (± 0.58)	0.91 (± 0.55)	1.27 (± 0.21)
Flexible fisher behaviour - IM	5.03 (± 1.07)	1.68 (± 1.42)	1.14 (± 0.68)	1.39 (± 0.8)	1.29 (± 0.27)
Increased fishing pressure drivers - IM	1.73 (± 0.37)	0.58 (± 0.49)	0.98 (± 0.6)	0.85 (± 0.51)	1.35 (± 0.16)
High Cost, Low Values - IM	1.52 (± 0.33)	0.52 (± 0.44)	0.62 (± 0.39)	0.67 (± 0.4)	1.89 (± 0.37)
Low Costs, High Values - IM	1.73 (± 0.37)	0.58 (± 0.49)	0.94 (± 0.57)	0.82 (± 0.49)	1.44 (± 0.15)
Standard Markets - IM	1.74 (± 0.37)	0.58 (± 0.5)	0.97 (± 0.62)	0.85 (± 0.49)	1.48 (± 0.15)
Technology Creep - IM	3.41 (± 0.72)	1.16 (± 0.98)	1.04 (± 0.65)	1.82 (± 1.01)	2.04 (± 0.01)
No Acclimation - 2010 coastal context - IM	0.39 (± 0.08)	7.95 (± 6.75)	1.57 (± 0.96)	15.76 (± 9.49)	2.34 (± 0.28)
No Acclimation - Cumulative impacts - SQ	0.38 (± 0.06)	7.9 (± 6.94)	1.38 (± 0.69)	14.33 (± 9.56)	1.74 (± 1.36)

Table A. 6: Mean relative landings (± s.e.) of each fished group in Atlantis-SE for each strategy-scenario combination under RCP 8.5. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics "Major fishery" is noted as there is no fishery initially.

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
No Climate change - 2010 context - SQ	0.88 (± 0.91)	55.46 (± 85.7)	1.19 (± 1.3)	0.42 (± 0.43)	0.4 (± 0.28)	31.22 (± 29.01)	2.9 (± 1.42)
2010 coastal context - Cap ecosystem take	1.78 (± 0.01)	2.01 (± 1)	2.26 (± 0.09)	0.02 (± 0.02)	0.02 (± 0.03)	0.64 (± 0.18)	1.47 (± 2.14)
2010 coastal context - Centralised mgmt.	1.79 (± 0.01)	1.92 (± 0.95)	2.23 (± 0.05)	0.05 (± 0.03)	0.02 (± 0.02)	0.83 (± 0.8)	0.83 (± 0.91)
2010 coastal context - FewMPA	1.78 (± 0.02)	1.85 (± 1.09)	1.26 (± 0.01)	2.23 (± 1.27)	1.05 (± 0.91)	1.38 (± 0.03)	1.13 (± 0.36)
2010 coastal context - Fragmented mgmt	1.78 (± 0.01)	2.21 (± 1.85)	2.26 (± 0.11)	0.03 (± 0.03)	0.01 (± 0.01)	0.42 (± 0.11)	1.94 (± 2.59)
2010 coastal context - ManyMPA	1.79 (± 0.1)	3.23 (± 0.42)	1.92 (± 0.33)	0 (± 0)	0 (± 0)	1.19 (± 0.03)	0.37 (± 0.24)
2010 coastal context - Seasons	1.18 (± 0.01)	0.49 (± 0.06)	1.39 (± 0.17)	0.44 (± 0.02)	0.71 (± 1.22)	2.38 (± 0.41)	3.72 (± 4.67)

Scenario	Mackerel	Morwong	Pilchards	Cardinalfish	Gemfish	Shallow Piscivores	Spotted warehou
2010 coastal context - SlowAssess	1.8 (± 0.04)	1.42 (± 0.24)	2.14 (± 0.19)	0.24 (± 0.37)	0.33 (± 0.56)	0.54 (± 0.13)	0.91 (± 1.31)
2010 coastal context - Integrated Mgmt (IM)	1.78 (± 0.01)	2.01 (± 1)	2.26 (± 0.09)	0.02 (± 0.02)	0.02 (± 0.03)	2.13 (± 1.65)	1.47 (± 2.14)
Cumulative impacts - 2010 Status Quo (SQ)	1.78 (± 0.04)	1.33 (± 0.57)	2.14 (± 0.31)	0 (± 0)	0 (± 0)	0.08 (± 0.03)	1.19 (± 1.81)
Cumulative impacts - Cap ecosystem take	1.77 (± 0.04)	2 (± 0.97)	2.15 (± 0.31)	0 (± 0)	0 (± 0)	0.06 (± 0.03)	2.15 (± 3.6)
Cumulative impacts - Centralised mgmt.	1.77 (± 0.04)	2.02 (± 1.3)	2.13 (± 0.3)	0 (± 0)	0 (± 0)	0.08 (± 0.07)	1.06 (± 1.65)
Cumulative impacts - FewMPA	1.77 (± 0.02)	2.37 (± 1.78)	1.2 (± 0.16)	0 (± 0)	0 (± 0)	0.12 (± 0.03)	0.68 (± 0.79)
Cumulative impacts - Fragmented mgmt	1.77 (± 0.04)	1.71 (± 0.34)	2.16 (± 0.38)	0 (± 0)	0 (± 0)	0.04 (± 0.01)	2.72 (± 4.47)
Cumulative impacts - ManyMPA	1.78 (± 0.13)	4.46 (± 3.57)	1.85 (± 0.57)	0 (± 0)	0 (± 0)	0.1 (± 0.03)	0.37 (± 0.49)
Cumulative impacts - Seasons	1.17 (± 0.01)	0.62 (± 0.46)	1.32 (± 0.22)	0 (± 0)	0 (± 0)	0.2 (± 0.06)	0.9 (± 0.67)
Cumulative impacts - SlowAssess	1.79 (± 0.07)	1.99 (± 1.6)	2.03 (± 0.09)	0 (± 0)	0 (± 0)	0.05 (± 0.03)	1.32 (± 2.22)
Cumulative impacts - IM	1.77 (± 0.04)	2 (± 0.97)	2.15 (± 0.31)	0 (± 0)	0 (± 0)	0.21 (± 0.19)	2.15 (± 3.6)
Expanded LTL fishery - IM	1.79 (± 0.01)	2.16 (± 0.61)	2.17 (± 0.03)	0.13 (± 0.06)	0.06 (± 0.08)	0.16 (± 0.27)	1.79 (± 2.25)
New mesopelgic fishery - IM	1.94 (± 0.03)	3.44 (± 2.49)	4.84 (± 0.42)	0.02 (± 0.02)	0.02 (± 0.02)	0.11 (± 0.1)	11.96 (± 15.55)
Extreme climate events - IM	1.93 (± 0.01)	3.61 (± 2.55)	4.83 (± 0.28)	0 (± 0)	0 (± 0)	0.46 (± 0.32)	15.94 (± 24.57)
Blooms - IM	1.93 (± 0.02)	3.66 (± 2.53)	4.84 (± 0.32)	0 (± 0)	0 (± 0)	1.01 (± 0.16)	11.52 (± 17.82)
Primary production regime shift - IM	1.96 (± 0.04)	3.64 (± 2.52)	4.81 (± 0.32)	0.1 (± 0.18)	0.01 (± 0.01)	0.51 (± 0.16)	15.7 (± 24.49)
Fish kills - IM	1.93 (± 0.01)	3.35 (± 2.52)	4.84 (± 0.29)	0 (± 0)	0 (± 0)	0.38 (± 0.21)	15.02 (± 24.93)
Range extensions - IM	1.8 (± 0.04)	1.21 (± 0.25)	2.14 (± 0.21)	0.83 (± 1.42)	5.67 (± 9.81)	0.56 (± 0.06)	4.13 (± 6.35)
Gear switching allowed - IM	1.77 (± 0.01)	1.61 (± 0.92)	1.26 (± 0.03)	0.62 (± 0.73)	0.34 (± 0.45)	0.84 (± 0.42)	0.21 (± 0.08)
High compliance - IM	1.79 (± 0.01)	2.06 (± 1.08)	2.21 (± 0.07)	0.06 (± 0.05)	0.04 (± 0.05)	0.68 (± 0.6)	1.43 (± 1.88)
Low Compliance - IM	1.79 (± 0.01)	1.94 (± 1.28)	2.36 (± 0.1)	0 (± 0)	0 (± 0)	0.91 (± 0.15)	1.52 (± 1.84)
Flexible fisher behaviour - IM	4.94 (± 0.03)	2.05 (± 0.69)	5.85 (± 0.18)	0.07 (± 0.03)	0.02 (± 0.02)	0.25 (± 0.43)	1.15 (± 1.31)
Increased fishing pressure drivers - IM	1.78 (± 0.01)	2.01 (± 1)	2.26 (± 0.09)	0.02 (± 0.02)	0.02 (± 0.03)	0.87 (± 0.17)	1.47 (± 2.14)
High Cost, Low Values - IM	1.79 (± 0.01)	3.68 (± 2.78)	1.25 (± 0.01)	1.85 (± 0.79)	0.66 (± 0.09)	1.38 (± 0.01)	1.96 (± 1.43)
Low Costs, High Values - IM	1.78 (± 0.01)	2.12 (± 1.78)	2.26 (± 0.09)	0.03 (± 0.03)	0.01 (± 0.01)	0.1 (± 0.09)	1.38 (± 2.1)
Standard Markets - IM	1.79 (± 0.01)	1.39 (± 0.79)	2.24 (± 0.06)	0.03 (± 0.02)	0.01 (± 0.01)	0.9 (± 0.12)	1 (± 0.93)
Technology Creep - IM	3.41 (± 0.02)	3.36 (± 1.24)	3.53 (± 0.35)	0.91 (± 0.12)	0.7 (± 1.16)	0.19 (± 0.31)	0.76 (± 0.54)
No Acclimation - 2010 coastal context - IM	0 (± 0)	0 (± 0)	0.02 (± 0)	0 (± 0)	38.71 (± 64.39)	0.24 (± 0.19)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	0 (± 0)	0.02 (± 0)	0 (± 0)	0 (± 0)	0.07 (± 0.05)	0 (± 0)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
No Climate change - 2010 context - SQ	0.03 (± 0.02)	1.23 (± 0.45)	0 (± 0)	0 (± 0)	0.71 (± 0.74)	0.15 (± 0.09)	0.83 (± 0.43)	2.3 (± 3.41)
2010 coastal context - Cap ecosystem take	0.86 (± 0.04)	3.78 (± 2.09)	0 (± 0)	0 (± 0)	1.03 (± 0.14)	0.09 (± 0.07)	0.68 (± 0.4)	0.14 (± 0.15)
2010 coastal context - Centralised mgmt.	0.85 (± 0.03)	3.03 (± 1.02)	0 (± 0)	0 (± 0)	0.96 (± 0.05)	0.08 (± 0.02)	0.55 (± 0.2)	0.26 (± 0.22)
2010 coastal context - FewMPA	0.9 (± 0.01)	4.47 (± 1.15)	0 (± 0)	0 (± 0)	0.95 (± 0.18)	0.19 (± 0.12)	0.25 (± 0.29)	1.96 (± 0.76)
2010 coastal context - Fragmented mgmt	0.86 (± 0.03)	3.17 (± 2.44)	0 (± 0)	0 (± 0)	1.08 (± 0.2)	0.12 (± 0.07)	0.61 (± 0.16)	0.21 (± 0.23)
2010 coastal context - ManyMPA	0.75 (± 0.01)	3.62 (± 1.53)	0 (± 0)	0 (± 0)	0.87 (± 0.1)	0 (± 0)	1.69 (± 0.65)	0 (± 0)
2010 coastal context - Seasons	0.01 (± 0)	3.72 (± 1.22)	0 (± 0)	0 (± 0)	1.21 (± 0.23)	0.05 (± 0.03)	0.44 (± 0.26)	1.57 (± 0.35)
2010 coastal context - SlowAssess	0.86 (± 0.04)	2.76 (± 0.97)	0 (± 0)	0 (± 0)	0.98 (± 0.06)	0.1 (± 0.03)	0.26 (± 0.14)	0.69 (± 0.89)
2010 coastal context - Integrated Mgmt (IM)	0.86 (± 0.04)	3.78 (± 2.09)	0 (± 0)	0 (± 0)	1.03 (± 0.14)	0.09 (± 0.07)	0.68 (± 0.4)	0.14 (± 0.15)
Cumulative impacts - 2010 Status Quo (SQ)	0.84 (± 0.01)	2.54 (± 2.8)	0 (± 0)	0 (± 0)	1.11 (± 0.15)	0.01 (± 0.02)	0.18 (± 0.1)	0 (± 0)
Cumulative impacts - Cap ecosystem take	0.84 (± 0.02)	2.67 (± 2.95)	0 (± 0)	0 (± 0)	1.17 (± 0.28)	0.02 (± 0.03)	0.19 (± 0.08)	0 (± 0)
Cumulative impacts - Centralised mgmt.	0.84 (± 0.02)	1.98 (± 1.87)	0 (± 0)	0 (± 0)	1.08 (± 0.15)	0.01 (± 0.02)	0.16 (± 0)	0 (± 0)
Cumulative impacts - FewMPA	0.89 (± 0.03)	2.8 (± 2.32)	0 (± 0)	0 (± 0)	1.06 (± 0.2)	0.02 (± 0.03)	0.11 (± 0.15)	0 (± 0)
Cumulative impacts - Fragmented mgmt	0.84 (± 0.01)	2.43 (± 2.82)	0 (± 0)	0 (± 0)	1.22 (± 0.35)	0.02 (± 0.04)	0.19 (± 0.05)	0 (± 0)
Cumulative impacts - ManyMPA	0.74 (± 0.01)	1.79 (± 0.99)	0 (± 0)	0 (± 0)	0.97 (± 0.02)	0 (± 0)	0.59 (± 0.37)	0 (± 0)
Cumulative impacts - Seasons	0.01 (± 0)	1.86 (± 0.94)	0 (± 0)	0 (± 0)	1.35 (± 0.23)	0 (± 0)	0.15 (± 0.12)	0 (± 0)
Cumulative impacts - SlowAssess	0.85 (± 0.03)	1.77 (± 1.77)	0 (± 0)	0 (± 0)	1.11 (± 0.18)	0.02 (± 0.02)	0.08 (± 0.01)	0 (± 0)
Cumulative impacts - IM	0.84 (± 0.02)	2.67 (± 2.95)	0 (± 0)	0 (± 0)	1.17 (± 0.28)	0.02 (± 0.03)	0.19 (± 0.08)	0 (± 0)
Expanded LTL fishery - IM	0.87 (± 0.03)	4.35 (± 1.24)	0 (± 0)	0 (± 0)	1.07 (± 0.18)	0.13 (± 0.03)	0.53 (± 0.17)	0.44 (± 0.21)
New mesopelgic fishery - IM	0.01 (± 0)	3.45 (± 1.56)	Major fishery	Major fishery	1.88 (± 0.24)	0.03 (± 0.02)	0.22 (± 0.14)	0.29 (± 0.26)
Extreme climate events - IM	0.01 (± 0)	2.88 (± 2.4)	0 (± 0)	0 (± 0)	1.91 (± 0.35)	0.02 (± 0.02)	0.17 (± 0.11)	0.06 (± 0.11)
Blooms - IM	0.01 (± 0)	2.47 (± 1.85)	0 (± 0)	0 (± 0)	1.84 (± 0.24)	0.02 (± 0.02)	0.11 (± 0.08)	0.11 (± 0.19)
Primary production regime shift - IM	0.01 (± 0)	3.62 (± 1.72)	0 (± 0)	0 (± 0)	1.94 (± 0.3)	0.04 (± 0.03)	0.28 (± 0.15)	0.31 (± 0.42)
Fish kills - IM	0.01 (± 0)	2.48 (± 2.36)	0 (± 0)	0 (± 0)	1.93 (± 0.37)	0.02 (± 0.02)	0.12 (± 0.13)	0.08 (± 0.14)
Range extensions - IM	0.86 (± 0.04)	3.96 (± 2.27)	0 (± 0)	0 (± 0)	1 (± 0.07)	0.08 (± 0.03)	0.67 (± 0.35)	1.2 (± 1.62)
Gear switching allowed - IM	0.89 (± 0.01)	5.47 (± 2.16)	0 (± 0)	0 (± 0)	0.83 (± 0.01)	0.07 (± 0.05)	0.51 (± 0.2)	1.19 (± 0.05)
High compliance - IM	0.86 (± 0.03)	2.93 (± 1.04)	0 (± 0)	0 (± 0)	1.04 (± 0.14)	0.1 (± 0.08)	0.69 (± 0.47)	0.19 (± 0.02)
Low Compliance - IM	0.86 (± 0.01)	2.24 (± 0.73)	0 (± 0)	0 (± 0)	0.98 (± 0.22)	0.07 (± 0.03)	0.44 (± 0.28)	0.08 (± 0.13)
Flexible fisher behaviour - IM	2.39 (± 0.05)	3.57 (± 0.59)	0 (± 0)	0 (± 0)	1.96 (± 0.07)	0.1 (± 0.02)	0.73 (± 0.48)	0.69 (± 0.77)

Scenario	Tuna	School whiting	Myctophids	Nonmigratory mesopelagics	Redbait	Dories & Orieos	Blue grenadier	Shallow demersalfish
Increased fishing pressure drivers - IM	0.86 (± 0.04)	3.78 (± 2.09)	0 (± 0)	0 (± 0)	1.03 (± 0.14)	0.09 (± 0.07)	0.68 (± 0.4)	0.14 (± 0.15)
High Cost, Low Values - IM	0.9 (± 0)	5.3 (± 1.08)	0 (± 0)	0 (± 0)	1.13 (± 0.31)	0.16 (± 0.07)	0.33 (± 0.02)	2.84 (± 1.43)
Low Costs, High Values - IM	0.86 (± 0.03)	3.35 (± 1.93)	0 (± 0)	0 (± 0)	1.02 (± 0.13)	0.1 (± 0.06)	0.82 (± 0.67)	0.2 (± 0.2)
Standard Markets - IM	0.86 (± 0.03)	3.6 (± 1.99)	0 (± 0)	0 (± 0)	0.99 (± 0.05)	0.09 (± 0.01)	0.62 (± 0.5)	0.22 (± 0.22)
Technology Creep - IM	1.72 (± 0.01)	4.63 (± 2.36)	0 (± 0)	0 (± 0)	1.59 (± 0.06)	0.12 (± 0.01)	0.49 (± 0.11)	1.62 (± 0.53)
No Acclimation - 2010 coastal context - IM	0.04 (± 0)	1.19 (± 0.66)	0 (± 0)	0 (± 0)	0 (± 0)	1.33 (± 1.01)	2.95 (± 1.73)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0.04 (± 0)	0.98 (± 0.74)	0 (± 0)	0 (± 0)	0 (± 0)	0.9 (± 0.71)	2.34 (± 2.42)	0 (± 0)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
No Climate change - 2010 context - SQ	0.6 (± 0.1)	1.39 (± 0.9)	4.23 (± 4.95)	2.01 (± 2.16)	0.36 (± 0.5)	1.79 (± 1.46)	1.98 (± 1.23)	1.73 (± 0.07)
2010 coastal context - Cap ecosystem take	2.22 (± 0.82)	0.59 (± 0.62)	1.76 (± 1.36)	2.24 (± 1.5)	0.27 (± 0.09)	0.58 (± 0.61)	8.16 (± 2.58)	1.73 (± 1.27)
2010 coastal context - Centralised mgmt.	1.35 (± 0.02)	0.46 (± 0.27)	0.81 (± 0.14)	2.4 (± 1.85)	0.32 (± 0.2)	0.59 (± 0.67)	6.97 (± 2.61)	1.39 (± 1.25)
2010 coastal context - FewMPA	1.23 (± 0.64)	1.01 (± 0.65)	0.87 (± 0.73)	1.77 (± 1.29)	1 (± 0.91)	0.08 (± 0.02)	0 (± 0)	1.18 (± 0.24)
2010 coastal context - Fragmented mgmt	0.31 (± 0.41)	0.77 (± 0.59)	1.24 (± 1.38)	2.58 (± 1.85)	0.37 (± 0.14)	0.47 (± 0.35)	8.69 (± 2.99)	1.38 (± 1.07)
2010 coastal context - ManyMPA	2.03 (± 1.76)	0.1 (± 0.09)	4.5 (± 3.07)	2.11 (± 3.41)	0.03 (± 0.02)	0.72 (± 0.03)	1.43 (± 1.35)	1.18 (± 0.08)
2010 coastal context - Seasons	0.51 (± 0.26)	0.37 (± 0.36)	1.65 (± 1.31)	4.25 (± 1.79)	0.08 (± 0.05)	0.82 (± 0.01)	0 (± 0)	2.21 (± 0.07)
2010 coastal context - SlowAssess	0.77 (± 0.3)	0.47 (± 0.28)	0.9 (± 0.56)	2.96 (± 0.66)	0.33 (± 0.24)	0.28 (± 0.31)	5.63 (± 4.55)	0.68 (± 0.27)
2010 coastal context - Integrated Mgmt (IM)	2.22 (± 0.82)	0.59 (± 0.62)	1.76 (± 1.36)	2.24 (± 1.5)	0.27 (± 0.09)	0.58 (± 0.61)	8.16 (± 2.58)	1.73 (± 1.27)
Cumulative impacts - 2010 Status Quo (SQ)	0.89 (± 0.83)	0.4 (± 0.56)	0.5 (± 0.41)	2.29 (± 0.78)	0.04 (± 0.04)	0.07 (± 0.03)	6.84 (± 1.58)	0.33 (± 0.02)
Cumulative impacts - Cap ecosystem take	199.55 (± 344.63)	0.75 (± 1.23)	0.84 (± 0.44)	1.65 (± 0.47)	0.06 (± 0.07)	0.11 (± 0.09)	7.7 (± 2.9)	0.47 (± 0.23)
Cumulative impacts - Centralised mgmt.	122.57 (± 211.58)	0.46 (± 0.7)	0.44 (± 0.15)	1.62 (± 0.85)	0.04 (± 0.04)	0.1 (± 0.04)	6.38 (± 1.72)	0.35 (± 0.04)
Cumulative impacts - FewMPA	44.06 (± 75.44)	0.6 (± 0.92)	0.52 (± 0.48)	1.99 (± 1.84)	0.09 (± 0.07)	0.04 (± 0.04)	0 (± 0)	0.53 (± 0.47)
Cumulative impacts - Fragmented mgmt	0.73 (± 0.95)	0.86 (± 1.35)	0.55 (± 0.5)	1.79 (± 0.63)	0.08 (± 0.09)	0.12 (± 0.12)	7.88 (± 0.95)	0.37 (± 0.11)
Cumulative impacts - ManyMPA	103.35 (± 177.29)	0.11 (± 0.17)	2.32 (± 1.2)	1.22 (± 1.89)	0.02 (± 0.03)	0.32 (± 0.28)	1.19 (± 0.87)	0.51 (± 0.37)
Cumulative impacts - Seasons	25.84 (± 44.47)	0.11 (± 0.14)	1.04 (± 1)	4.21 (± 2.53)	0.03 (± 0.05)	0.36 (± 0.31)	0 (± 0)	0.93 (± 0.66)
Cumulative impacts - SlowAssess	39.51 (± 67.92)	0.46 (± 0.74)	0.44 (± 0.17)	3.61 (± 3.41)	0.05 (± 0.05)	0.06 (± 0.02)	5.04 (± 3.96)	0.24 (± 0.14)
Cumulative impacts - IM	199.55 (± 344.63)	0.75 (± 1.23)	0.84 (± 0.44)	1.65 (± 0.47)	0.06 (± 0.07)	0.11 (± 0.09)	7.7 (± 2.9)	0.47 (± 0.23)
Expanded LTL fishery - IM	1.38 (± 0.14)	0.76 (± 0.42)	0.6 (± 0.17)	2.39 (± 1.64)	0.52 (± 0.32)	0.56 (± 0.58)	5.49 (± 3.25)	1.13 (± 0.87)
New mesopelgic fishery - IM	0.64 (± 0.29)	0.41 (± 0.28)	1.02 (± 0.45)	4.35 (± 4.92)	0.08 (± 0.05)	1.19 (± 1.96)	64.72 (± 33.17)	2.78 (± 3.41)
Extreme climate events - IM	0.92 (± 0.26)	0.31 (± 0.37)	1.79 (± 0.13)	3.23 (± 2.91)	0.01 (± 0.01)	0.51 (± 0.8)	68.82 (± 11.01)	2.56 (± 2.56)
Blooms - IM	0.71 (± 0.42)	0.3 (± 0.38)	1.79 (± 0.1)	3.34 (± 3.27)	0.02 (± 0)	0.26 (± 0.38)	86.36 (± 22.94)	1.55 (± 1.46)

Scenario	Redfish	Ribaldo	Flathead	Ling	Orange roughy	Blueeye Trevalla	Gummy Shark	Demersal Shark
Primary production regime shift - IM	1.29 (± 0.34)	0.41 (± 0.36)	1.57 (± 0.38)	4.4 (± 1.9)	0.06 (± 0.07)	0.86 (± 0.71)	51.42 (± 35.87)	2.52 (± 2.52)
Fish kills - IM	0.44 (± 0.22)	0.28 (± 0.38)	1.97 (± 0.26)	2.94 (± 2.81)	0.02 (± 0)	0.53 (± 0.8)	85.13 (± 18.79)	2.28 (± 2.67)
Range extensions - IM	2.63 (± 1.15)	0.71 (± 0.57)	1.27 (± 0.74)	3.63 (± 0.76)	0.33 (± 0.16)	0.29 (± 0.21)	6.98 (± 5.6)	0.84 (± 0.27)
Gear switching allowed - IM	1.73 (± 0.83)	0.35 (± 0.13)	0.72 (± 0.62)	3.03 (± 0.38)	0.28 (± 0.36)	0.44 (± 0.03)	0.3 (± 0.12)	0.72 (± 0.03)
High compliance - IM	1.65 (± 0.7)	0.61 (± 0.6)	0.82 (± 0.09)	2.1 (± 1.31)	0.29 (± 0.28)	0.84 (± 0.68)	6.43 (± 1.98)	1.69 (± 1.11)
Low Compliance - IM	0.87 (± 0.34)	0.62 (± 0.46)	0.59 (± 0.58)	2.27 (± 1.19)	0.25 (± 0.13)	0.43 (± 0.26)	7.82 (± 2.93)	1.2 (± 0.1)
Flexible fisher behaviour - IM	2.04 (± 0.88)	0.51 (± 0.24)	0.91 (± 0.25)	2.28 (± 1.23)	0.39 (± 0.23)	0.74 (± 0.64)	6.58 (± 1.99)	1.65 (± 1.15)
Increased fishing pressure drivers - IM	2.22 (± 0.82)	0.59 (± 0.62)	1.76 (± 1.36)	2.24 (± 1.5)	0.27 (± 0.09)	0.58 (± 0.61)	8.16 (± 2.58)	1.73 (± 1.27)
High Cost, Low Values - IM	1.31 (± 0.22)	1.03 (± 0.6)	0.65 (± 0.71)	1.71 (± 0.94)	0.91 (± 0.71)	0.25 (± 0.05)	0 (± 0)	1.28 (± 0.05)
Low Costs, High Values - IM	1.66 (± 0.64)	0.55 (± 0.54)	5.47 (± 3.72)	2.15 (± 1.35)	0.31 (± 0.2)	0.56 (± 0.44)	7.54 (± 1.63)	1.46 (± 0.82)
Standard Markets - IM	0.88 (± 0.77)	0.52 (± 0.12)	1.12 (± 1.16)	3.21 (± 2.23)	0.3 (± 0.18)	0.6 (± 0.89)	7.69 (± 3.7)	1.46 (± 1.51)
Technology Creep - IM	2.06 (± 0.59)	0.69 (± 0.27)	1.52 (± 1.21)	1.86 (± 0.85)	0.52 (± 0.33)	0.4 (± 0.19)	1.57 (± 1.22)	1.04 (± 0.12)
No Acclimation - 2010 coastal context - IM	0.41 (± 0.15)	3.17 (± 3.32)	6.19 (± 4.79)	0.07 (± 0.04)	0.52 (± 0.17)	0 (± 0)	0.1 (± 0.03)	2.56 (± 1.88)
No Acclimation - Cumulative impacts - SQ	0.28 (± 0.06)	2.08 (± 1.29)	3.93 (± 4.13)	0.08 (± 0.06)	0.32 (± 0.34)	0 (± 0)	0.08 (± 0.02)	2.09 (± 2.3)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
No Climate change - 2010 context - SQ	0.77 (± 0.64)	9.83 (± 6.61)	1.23 (± 0.36)	0.74 (± 0.86)	1.56 (± 0.71)	0.2 (± 0.11)	5.51 (± 4.72)	0.19 (± 0.07)
2010 coastal context - Cap ecosystem take	13.15 (± 10.72)	1.01 (± 0.04)	1.41 (± 0.29)	4.71 (± 0.94)	1.52 (± 0.13)	2.33 (± 0.06)	2213.14 (± 3832.91)	0.13 (± 0.02)
2010 coastal context - Centralised mgmt.	9.74 (± 8.85)	1.02 (± 0.04)	1.27 (± 0.19)	4.83 (± 0.67)	1.52 (± 0.14)	2.13 (± 0.06)	0.64 (± 0.23)	0.14 (± 0.02)
2010 coastal context - FewMPA	1.1 (± 0.8)	1.28 (± 0)	17.53 (± 1.99)	2.88 (± 0.9)	0.85 (± 0.04)	0.27 (± 0)	95.04 (± 159.69)	0.18 (± 0)
2010 coastal context - Fragmented mgmt	10.81 (± 6.97)	1.01 (± 0.02)	1.3 (± 0.16)	4.46 (± 0.63)	1.54 (± 0.15)	0.39 (± 0.04)	0.51 (± 0.24)	0.14 (± 0.01)
2010 coastal context - ManyMPA	0.53 (± 0.46)	1.12 (± 0.04)	5.85 (± 0.65)	0.02 (± 0.01)	1.6 (± 0.16)	0.23 (± 0)	0.42 (± 0.1)	1.54 (± 0.11)
2010 coastal context - Seasons	3.54 (± 0.26)	4.93 (± 0.05)	81.43 (± 14.66)	5.67 (± 1.02)	0.49 (± 0.08)	0.34 (± 0)	4.38 (± 0.11)	0.09 (± 0.01)
2010 coastal context - SlowAssess	4.46 (± 3.75)	1.26 (± 0.05)	1.35 (± 0.37)	6.38 (± 3.7)	1.5 (± 0.19)	0.15 (± 0.03)	1.75 (± 1.21)	0.39 (± 0.44)
2010 coastal context - Integrated Mgmt (IM)	13.15 (± 10.72)	1.01 (± 0.04)	1.41 (± 0.29)	4.71 (± 0.94)	1.52 (± 0.13)	0.27 (± 0.06)	22.76 (± 37.8)	0.13 (± 0.02)
Cumulative impacts - 2010 Status Quo (SQ)	1.08 (± 0.93)	0.99 (± 0.01)	3.74 (± 0.02)	1.96 (± 0.34)	1.66 (± 0.19)	0.4 (± 0)	0 (± 0)	0.03 (± 0)
Cumulative impacts - Cap ecosystem take	1.12 (± 0.61)	0.99 (± 0.02)	4.33 (± 0.24)	2.01 (± 0.4)	1.63 (± 0.19)	0.27 (± 0.01)	154.14 (± 266.98)	0.03 (± 0)
Cumulative impacts - Centralised mgmt.	0.92 (± 0.52)	0.99 (± 0.02)	3.92 (± 0.15)	2.06 (± 0.28)	1.64 (± 0.19)	0.24 (± 0.01)	189.18 (± 327.67)	0.03 (± 0)
Cumulative impacts - FewMPA	0.21 (± 0.28)	1.25 (± 0.01)	55.21 (± 12.28)	1.22 (± 0.37)	0.91 (± 0.04)	0.19 (± 0.01)	0.07 (± 0.11)	0.04 (± 0)
Cumulative impacts - Fragmented mgmt	1.06 (± 0.3)	0.99 (± 0.01)	4.04 (± 0.28)	1.9 (± 0.28)	1.65 (± 0.21)	0.28 (± 0.01)	0.01 (± 0.02)	0.03 (± 0)
Cumulative impacts - ManyMPA	0.07 (± 0.06)	1.1 (± 0.04)	18.65 (± 5.25)	0.01 (± 0)	1.72 (± 0.22)	0.16 (± 0)	0.12 (± 0.21)	0.31 (± 0.03)

Scenario	Deepwater Dogfish	Pelagic Shark	School Shark	Skates & Rays	Spotted Warehou	Gulper shark	Squid	Scallops
Cumulative impacts - Seasons	0.51 (± 0.45)	4.84 (± 0.09)	259.44 (± 76.31)	2.41 (± 0.39)	0.52 (± 0.07)	0.24 (± 0.01)	10.22 (± 17.7)	0.02 (± 0)
Cumulative impacts - SlowAssess	0.46 (± 0.24)	1.24 (± 0.06)	4.13 (± 0.35)	2.73 (± 1.62)	1.61 (± 0.23)	0.11 (± 0.01)	0 (± 0)	0.08 (± 0.09)
Cumulative impacts - IM	1.12 (± 0.61)	0.99 (± 0.02)	4.33 (± 0.24)	2.01 (± 0.4)	1.63 (± 0.19)	0.2 (± 0.01)	0.15 (± 0.27)	0.03 (± 0)
Expanded LTL fishery - IM	8.5 (± 6.53)	1.01 (± 0.03)	1.23 (± 0.13)	5.13 (± 1.01)	1.59 (± 0.17)	0.29 (± 0.05)	0.82 (± 0.17)	0.15 (± 0.01)
New mesopelgic fishery - IM	8.25 (± 11.05)	1.26 (± 0.04)	2.05 (± 0.17)	6.13 (± 1.89)	1.26 (± 0.03)	0.19 (± 0.02)	1.33 (± 0.73)	0.08 (± 0.01)
Extreme climate events - IM	6.14 (± 8.77)	1.29 (± 0.07)	2.63 (± 0.32)	5.68 (± 1.66)	1.23 (± 0.07)	0.42 (± 0.02)	0.23 (± 0.34)	0.07 (± 0.01)
Blooms - IM	3.92 (± 5.16)	1.38 (± 0.05)	2.72 (± 0.36)	5.5 (± 0.59)	1.17 (± 0.15)	0.08 (± 0.01)	0.11 (± 0.06)	0.07 (± 0.01)
Primary production regime shift - IM	7.73 (± 7.1)	1.51 (± 0.39)	2.3 (± 0.59)	7.96 (± 4.43)	1.21 (± 0.08)	0.08 (± 0.01)	2.56 (± 3.91)	0.3 (± 0.41)
Fish kills - IM	5.84 (± 9)	1.36 (± 0.09)	2.56 (± 0.26)	5.37 (± 0.89)	1.17 (± 0.13)	0.07 (± 0.02)	0.25 (± 0.23)	0.07 (± 0.01)
Range extensions - IM	8.06 (± 5.68)	1.04 (± 0.03)	1.21 (± 0.32)	7.17 (± 4.56)	1.47 (± 0.19)	0.07 (± 0.03)	3.22 (± 4.86)	0.41 (± 0.49)
Gear switching allowed - IM	5.35 (± 1)	1.01 (± 0.1)	4.68 (± 4.42)	4.62 (± 0.66)	0.83 (± 0.02)	0.08 (± 0)	3.35 (± 0.02)	0.17 (± 0.01)
High compliance - IM	13.34 (± 10.79)	1.01 (± 0.02)	1.66 (± 0.63)	5.3 (± 1.22)	1.55 (± 0.15)	0.34 (± 0.07)	0.57 (± 0.46)	0.14 (± 0.03)
Low Compliance - IM	6.02 (± 2.27)	1.08 (± 0.05)	1.75 (± 0.27)	4.41 (± 0.52)	1.62 (± 0.19)	1.27 (± 0.01)	0.12 (± 0.08)	0.13 (± 0.01)
Flexible fisher behaviour - IM	12.44 (± 8.72)	1.19 (± 0.06)	1.75 (± 0.11)	4.97 (± 0.64)	3.22 (± 0.31)	0.27 (± 0.06)	0.76 (± 0.12)	0.42 (± 0.04)
Increased fishing pressure drivers - IM	13.15 (± 10.72)	1.01 (± 0.04)	1.41 (± 0.29)	4.71 (± 0.94)	1.52 (± 0.13)	0.81 (± 0.06)	0.36 (± 0.27)	0.13 (± 0.02)
High Cost, Low Values - IM	1.67 (± 0.48)	1.18 (± 0.01)	15.72 (± 0.86)	3.14 (± 0.69)	0.87 (± 0.02)	0.27 (± 0)	2.86 (± 0.04)	0.18 (± 0)
Low Costs, High Values - IM	12.56 (± 9.05)	1.02 (± 0.04)	1.3 (± 0.24)	4.7 (± 0.96)	1.52 (± 0.13)	0.27 (± 0.04)	154.04 (± 265.94)	0.14 (± 0.01)
Standard Markets - IM	10.95 (± 13.71)	1.01 (± 0.03)	1.22 (± 0.24)	4.59 (± 0.78)	1.54 (± 0.13)	0.66 (± 0.1)	0.64 (± 0.26)	0.14 (± 0.02)
Technology Creep - IM	6.77 (± 1.54)	1.34 (± 0.02)	1.3 (± 0.15)	7.9 (± 0.78)	2.38 (± 0.26)	0.38 (± 0)	5.14 (± 1.07)	0.32 (± 0.01)
No Acclimation - 2010 coastal context - IM	0.27 (± 0.22)	54.11 (± 1.92)	1.3 (± 0.27)	4.5 (± 0.89)	0.02 (± 0)	0.34 (± 0.55)	107.41 (± 79.93)	0.19 (± 0.03)
No Acclimation - Cumulative impacts - SQ	0.2 (± 0.3)	53.45 (± 1.03)	1.83 (± 1.44)	3.69 (± 1.86)	0.02 (± 0)	0.98 (± 0.89)	156.5 (± 135.54)	0.16 (± 0.1)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
No Climate change - 2010 context - SQ	1.47 (± 0.11)	1.35 (± 0.21)	1.5 (± 0.51)	1.97 (± 1.05)	1.43 (± 0.17)
2010 coastal context - Cap ecosystem take	6.17 (± 0.04)	0.08 (± 0)	0.55 (± 0.02)	0.61 (± 0.02)	0.67 (± 0.03)
2010 coastal context - Centralised mgmt.	6.17 (± 0.04)	0.08 (± 0)	0.55 (± 0.02)	0.62 (± 0.03)	0.65 (± 0.09)
2010 coastal context - FewMPA	5.25 (± 0.02)	0.07 (± 0)	0.31 (± 0.05)	0.38 (± 0.05)	0.67 (± 0.06)
2010 coastal context - Fragmented mgmt	6.17 (± 0.04)	0.08 (± 0)	0.55 (± 0.01)	0.61 (± 0.01)	0.71 (± 0.03)
2010 coastal context - ManyMPA	6.52 (± 0.09)	0.17 (± 0.01)	0.22 (± 0.04)	0.16 (± 0.01)	0.06 (± 0.01)
2010 coastal context - Seasons	3.64 (± 0.02)	0.07 (± 0)	0.41 (± 0.01)	0.58 (± 0.02)	1.39 (± 0.04)
2010 coastal context - SlowAssess	8.04 (± 3.25)	0.16 (± 0.14)	0.56 (± 0.02)	1.08 (± 0.81)	0.69 (± 0.05)

Scenario	Oysters	Urchins & Abalone	Lobster	Shallow crustaceans	Prawns
2010 coastal context - Integrated Mgmt (IM)	6.17 (± 0.04)	0.08 (± 0)	0.55 (± 0.02)	0.61 (± 0.02)	0.67 (± 0.03)
Cumulative impacts - 2010 Status Quo (SQ)	5.74 (± 0.03)	0.07 (± 0)	0.46 (± 0.02)	0.47 (± 0.02)	0.06 (± 0.01)
Cumulative impacts - Cap ecosystem take	5.74 (± 0.03)	0.07 (± 0)	0.47 (± 0.02)	0.47 (± 0.03)	0.06 (± 0.01)
Cumulative impacts - Centralised mgmt.	5.75 (± 0.03)	0.07 (± 0)	0.47 (± 0.04)	0.47 (± 0.04)	0.05 (± 0)
Cumulative impacts - FewMPA	4.88 (± 0.02)	0.06 (± 0)	0.27 (± 0.05)	0.29 (± 0.04)	0.05 (± 0.01)
Cumulative impacts - Fragmented mgmt	5.74 (± 0.03)	0.07 (± 0)	0.47 (± 0.02)	0.47 (± 0.02)	0.06 (± 0.01)
Cumulative impacts - ManyMPA	6.07 (± 0.07)	0.14 (± 0.01)	0.18 (± 0.03)	0.12 (± 0.01)	0.01 (± 0)
Cumulative impacts - Seasons	3.39 (± 0.02)	0.06 (± 0)	0.35 (± 0.02)	0.44 (± 0.03)	0.11 (± 0.02)
Cumulative impacts - SlowAssess	7.49 (± 3.06)	0.14 (± 0.12)	0.48 (± 0.04)	0.84 (± 0.66)	0.06 (± 0.01)
Cumulative impacts - IM	5.74 (± 0.03)	0.07 (± 0)	0.47 (± 0.02)	0.47 (± 0.03)	0.06 (± 0.01)
Expanded LTL fishery - IM	6.18 (± 0.03)	0.08 (± 0)	0.56 (± 0.02)	0.63 (± 0.02)	0.72 (± 0.03)
New mesopelgic fishery - IM	6.92 (± 0.05)	0.12 (± 0)	0.61 (± 0.04)	0.77 (± 0.05)	0.98 (± 0.04)
Extreme climate events - IM	6.9 (± 0.04)	0.12 (± 0)	0.59 (± 0.04)	0.74 (± 0.06)	0.92 (± 0.05)
Blooms - IM	6.89 (± 0.04)	0.12 (± 0)	0.62 (± 0.04)	0.76 (± 0.03)	0.88 (± 0.02)
Primary production regime shift - IM	8.93 (± 3.57)	0.24 (± 0.22)	0.61 (± 0.03)	1.62 (± 1.53)	0.97 (± 0.17)
Fish kills - IM	6.9 (± 0.05)	0.12 (± 0)	0.6 (± 0.04)	0.74 (± 0.04)	0.96 (± 0.03)
Range extensions - IM	8.05 (± 3.26)	0.16 (± 0.14)	0.56 (± 0.02)	1.08 (± 0.81)	0.71 (± 0.03)
Gear switching allowed - IM	5.78 (± 0.03)	0.08 (± 0)	0.5 (± 0.02)	0.62 (± 0.02)	1.04 (± 0.04)
High compliance - IM	6.17 (± 0.04)	0.08 (± 0)	0.57 (± 0.01)	0.63 (± 0.02)	0.66 (± 0.07)
Low Compliance - IM	6.15 (± 0.04)	0.08 (± 0)	0.58 (± 0.02)	0.65 (± 0.02)	0.63 (± 0.02)
Flexible fisher behaviour - IM	17.89 (± 0.1)	0.24 (± 0)	0.65 (± 0.02)	1.01 (± 0.02)	0.64 (± 0.04)
Increased fishing pressure drivers - IM	6.17 (± 0.04)	0.08 (± 0)	0.55 (± 0.02)	0.61 (± 0.02)	0.67 (± 0.03)
High Cost, Low Values - IM	5.42 (± 0.02)	0.07 (± 0)	0.34 (± 0.01)	0.48 (± 0.02)	0.94 (± 0.05)
Low Costs, High Values - IM	6.17 (± 0.04)	0.08 (± 0)	0.53 (± 0)	0.59 (± 0.02)	0.72 (± 0.03)
Standard Markets - IM	6.17 (± 0.04)	0.08 (± 0)	0.54 (± 0.01)	0.61 (± 0.01)	0.74 (± 0.05)
Technology Creep - IM	12.11 (± 0.06)	0.16 (± 0)	0.59 (± 0.02)	1.33 (± 0.03)	1.03 (± 0.15)
No Acclimation - 2010 coastal context - IM	1.39 (± 0.01)	1.12 (± 0)	0.88 (± 0.03)	11.34 (± 0.37)	1.17 (± 0.05)
No Acclimation - Cumulative impacts - SQ	1.36 (± 0.06)	1.07 (± 0.11)	0.81 (± 0.08)	10.34 (± 1.82)	0.92 (± 0.72)

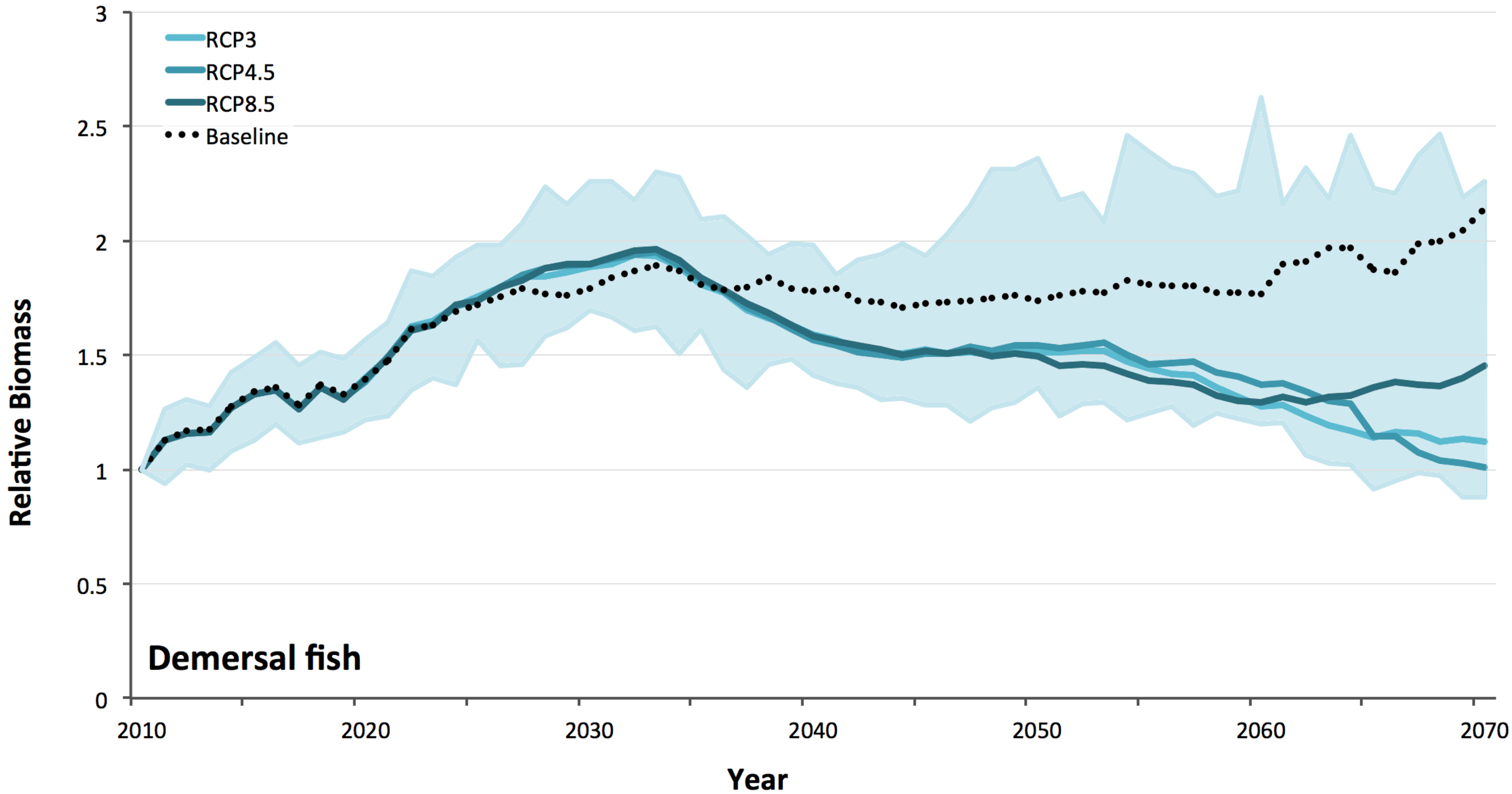


Figure A. 1: The average relative biomass of demersal fish through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

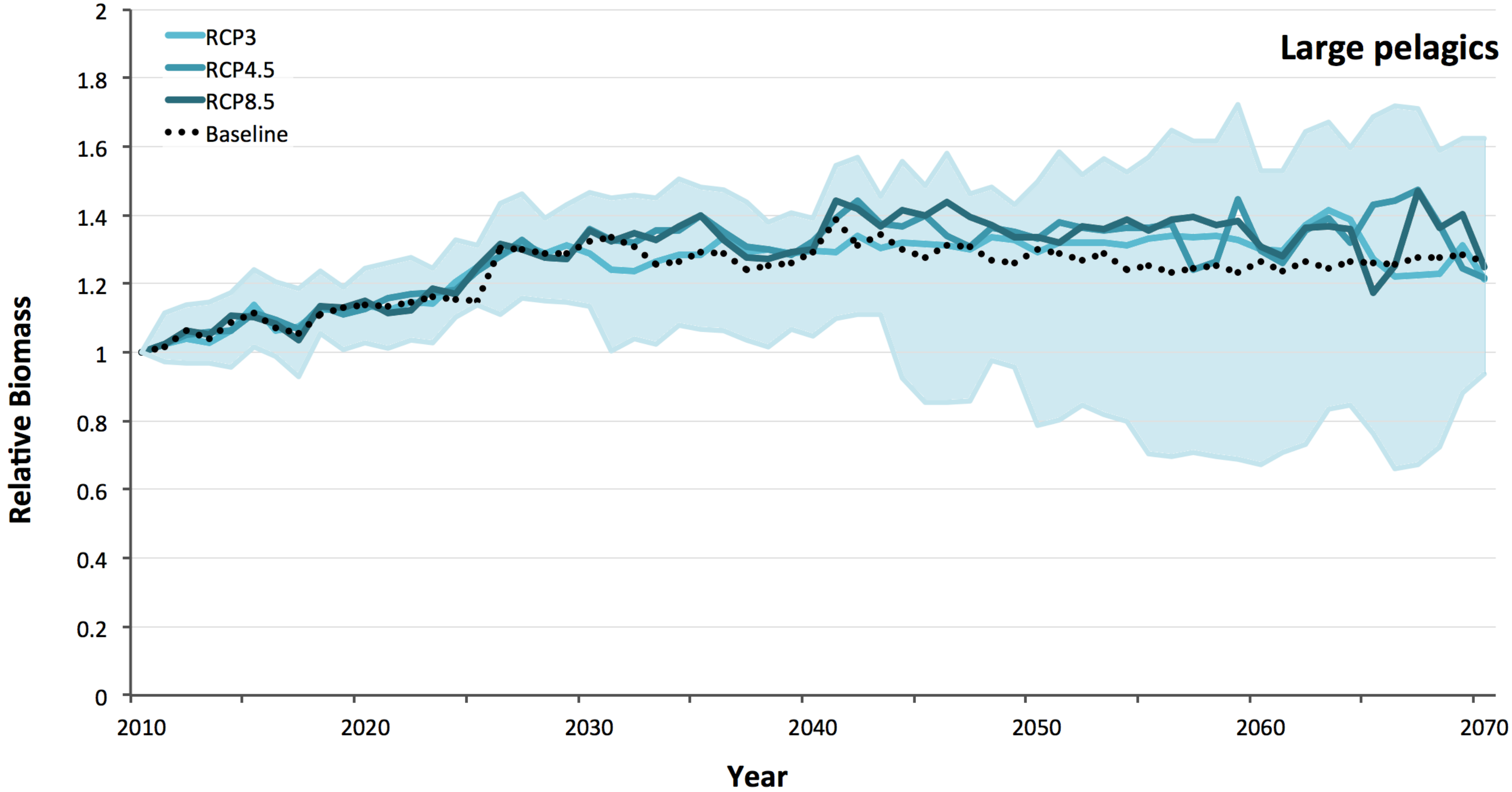


Figure A. 2: The average relative biomass of large pelagic fish through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

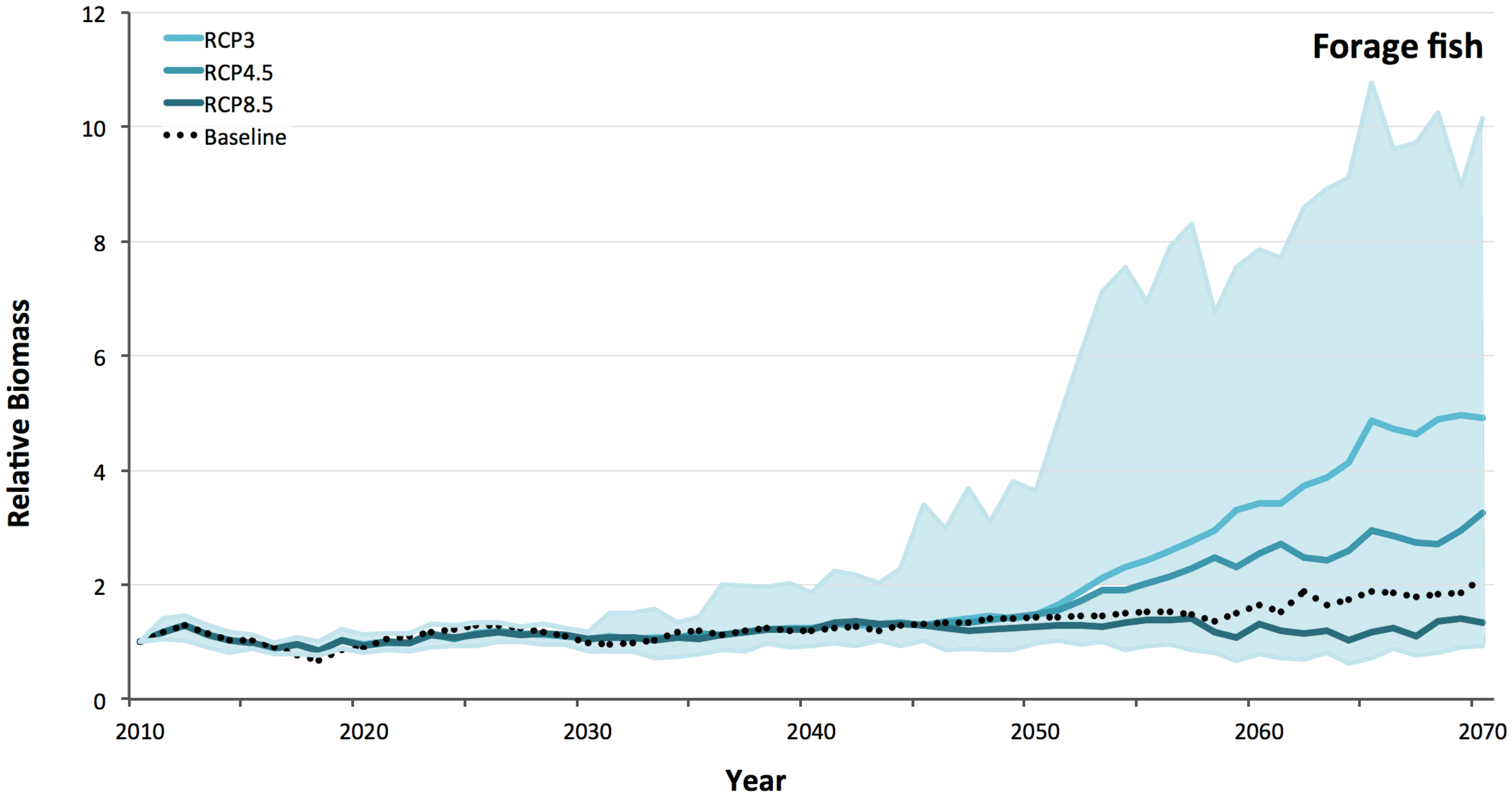


Figure A. 3: The average relative biomass of forage fish through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

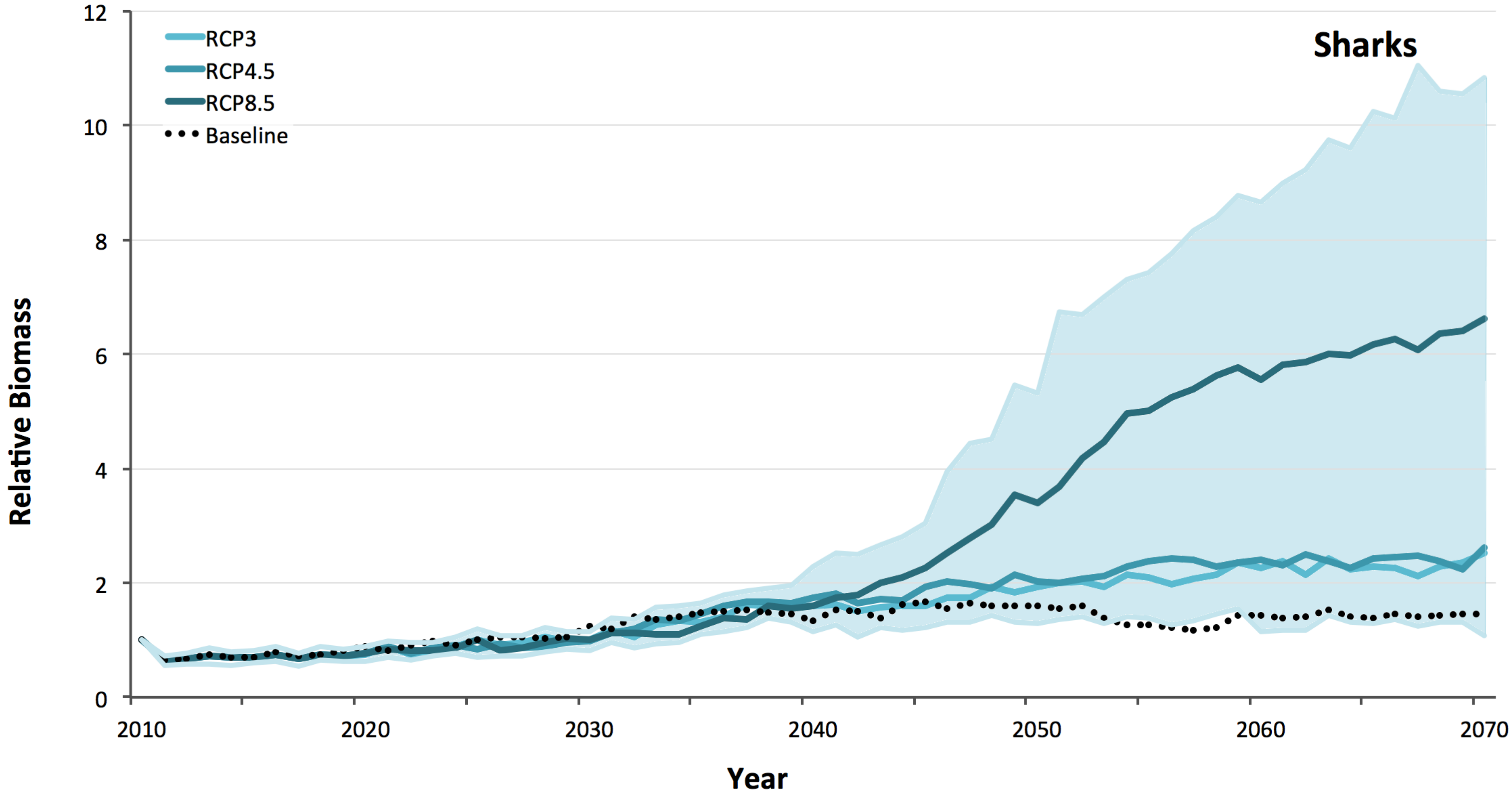


Figure A. 4: The average relative biomass of sharks through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

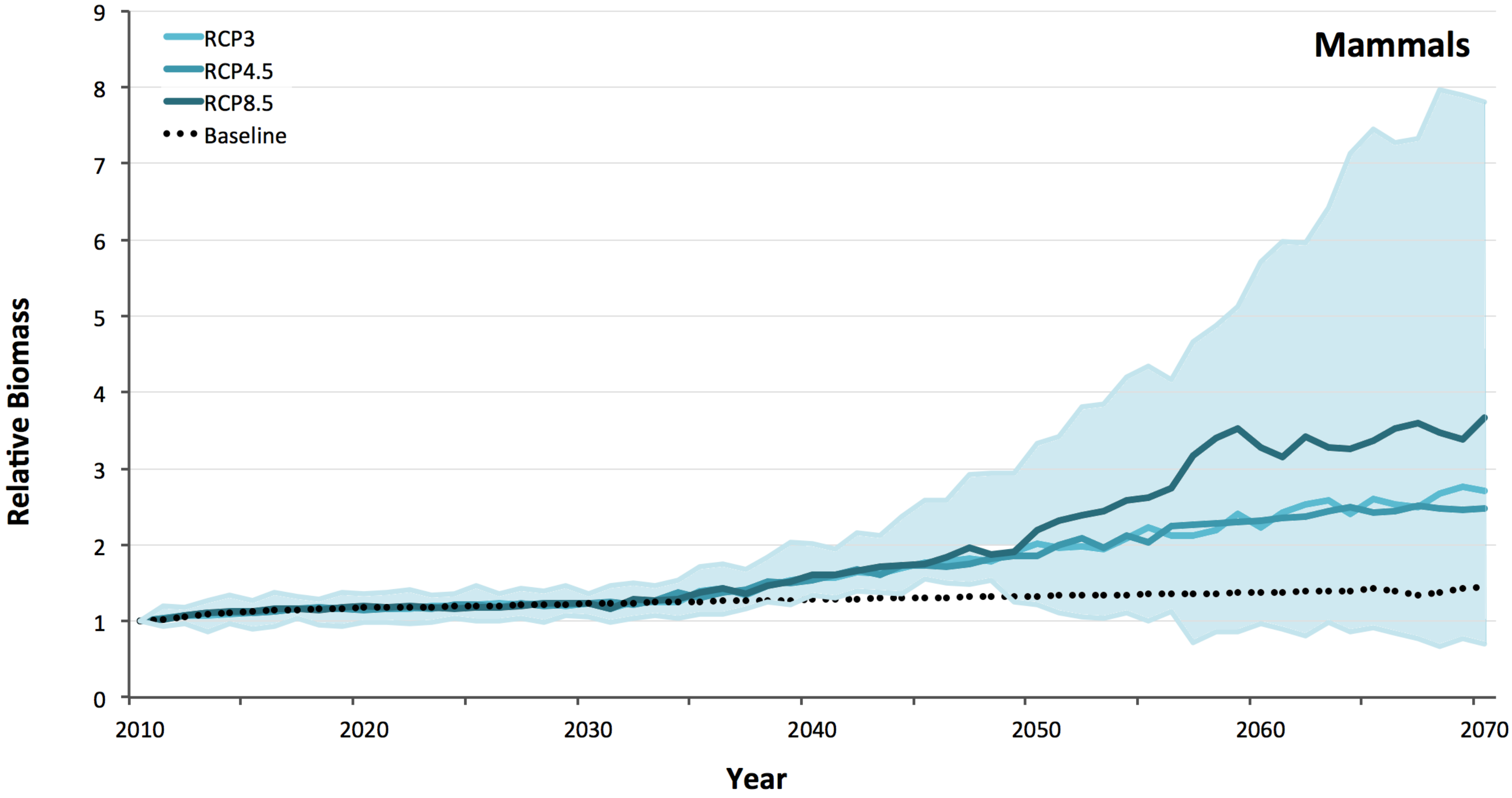


Figure A. 5: The average relative biomass of mammals through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

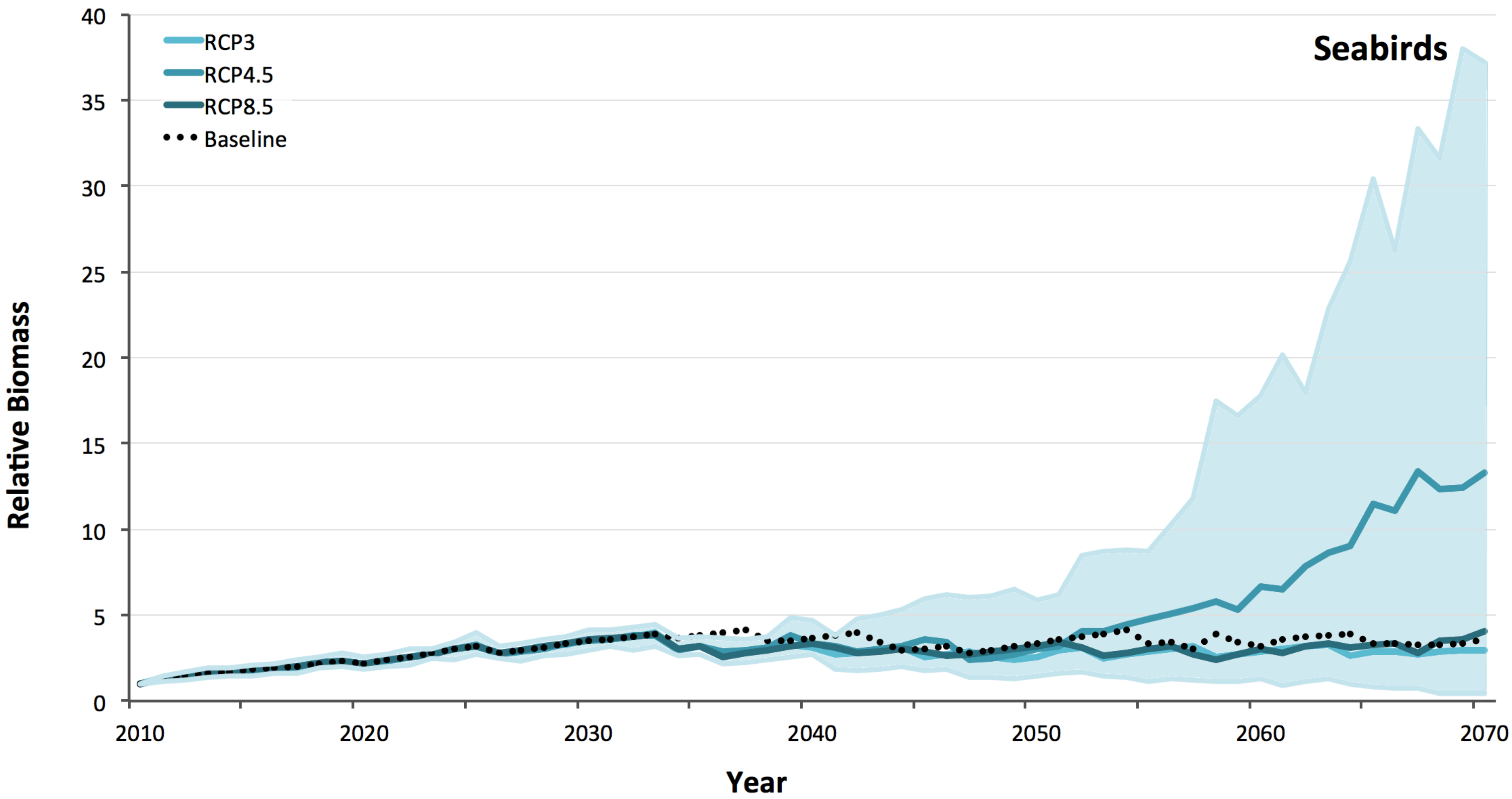


Figure A. 6: The average relative biomass of seabirds through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

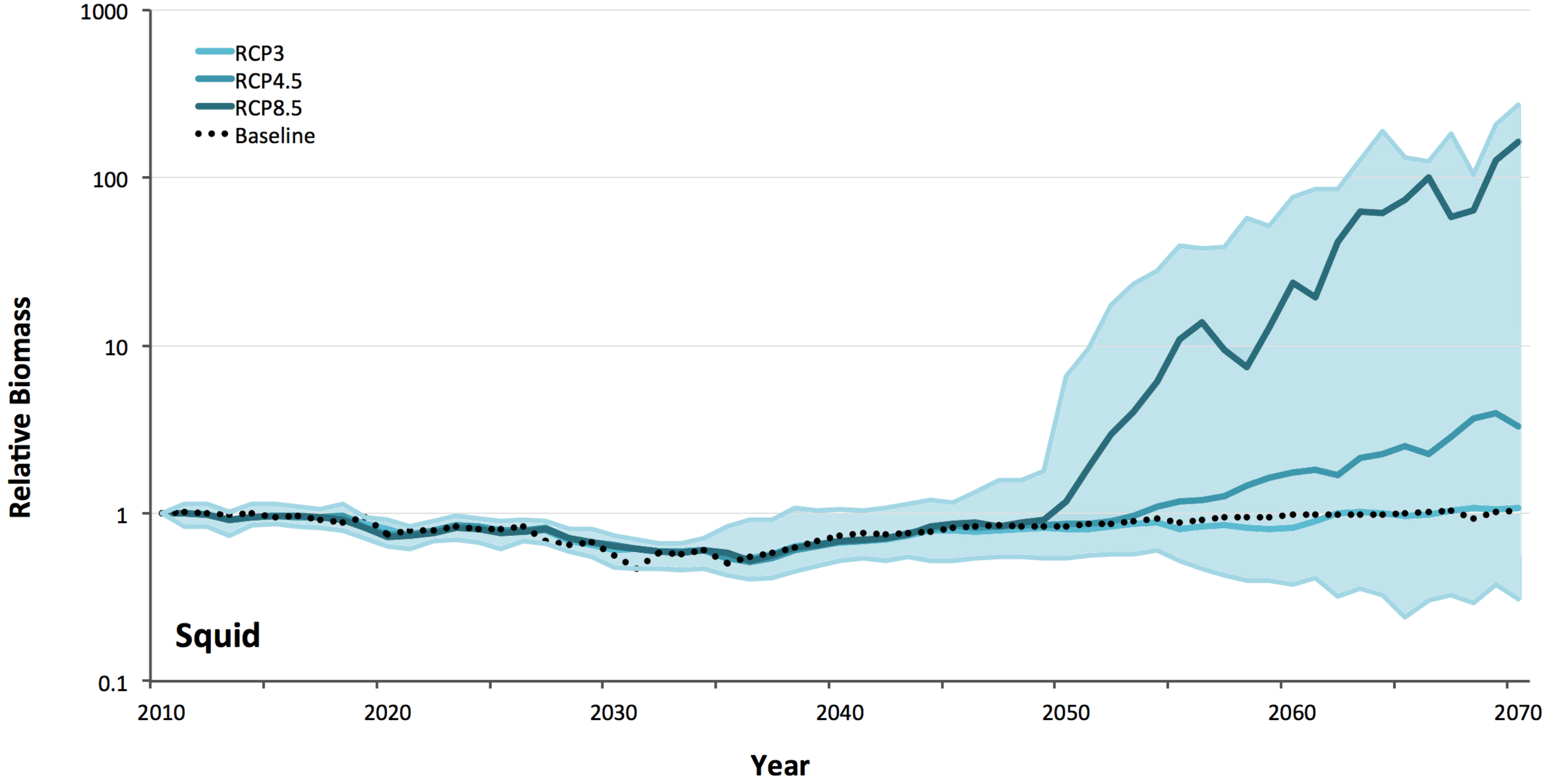


Figure A. 7: The average relative biomass of squid through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range. Reproduced from Figure 22 so that a complete set of group types is presented here as a set.

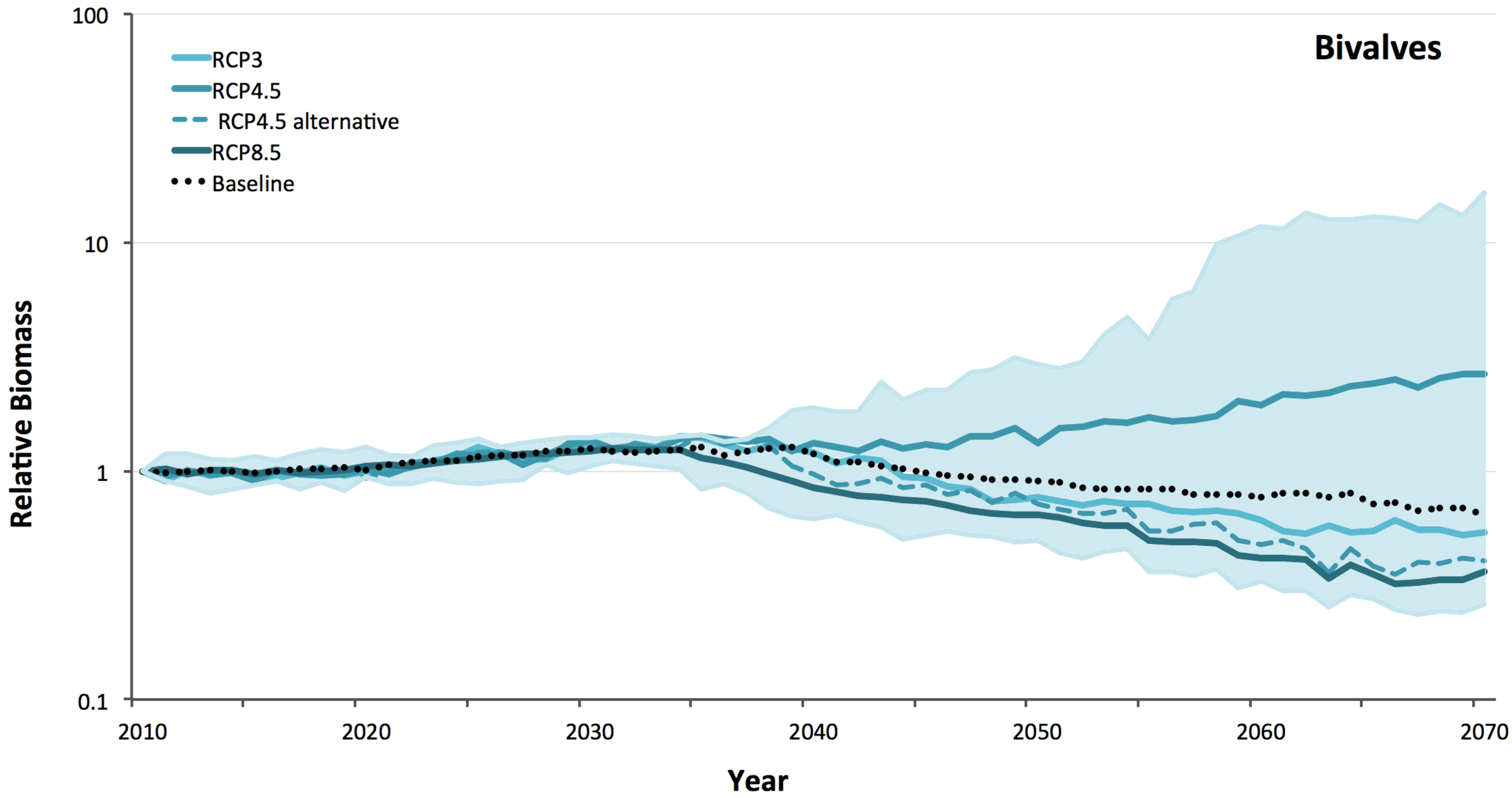


Figure A. 8: The average relative biomass of bivalves through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range. Note that the strong increase under RCP 4.5 comes largely from deep filter feeders under one parameterisation where the temperature benefits outweighed acidification impacts, the dashed line shows the alternative mean if that parameterisation is omitted.

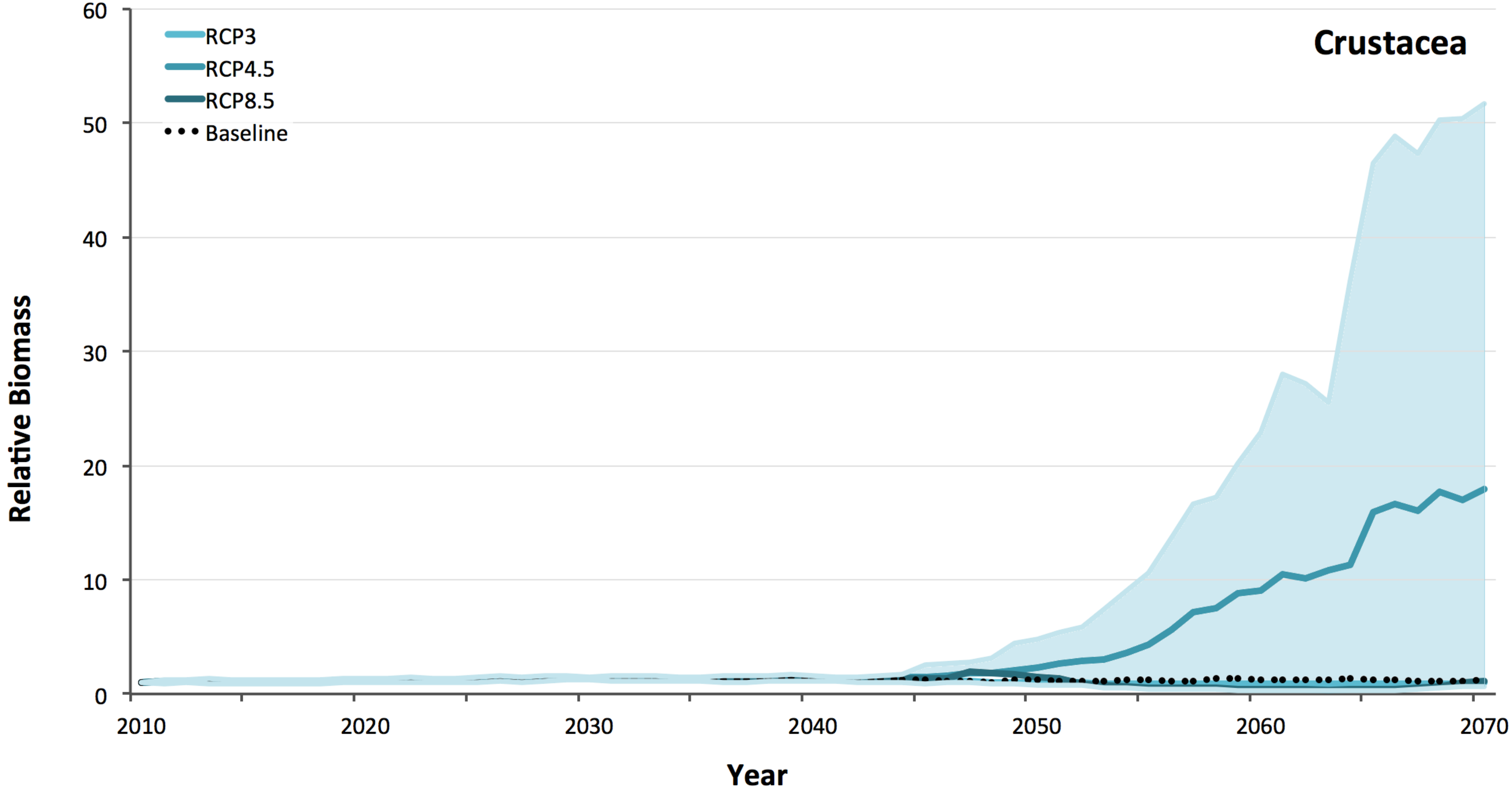


Figure A. 9: The average relative biomass of crustaceans through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

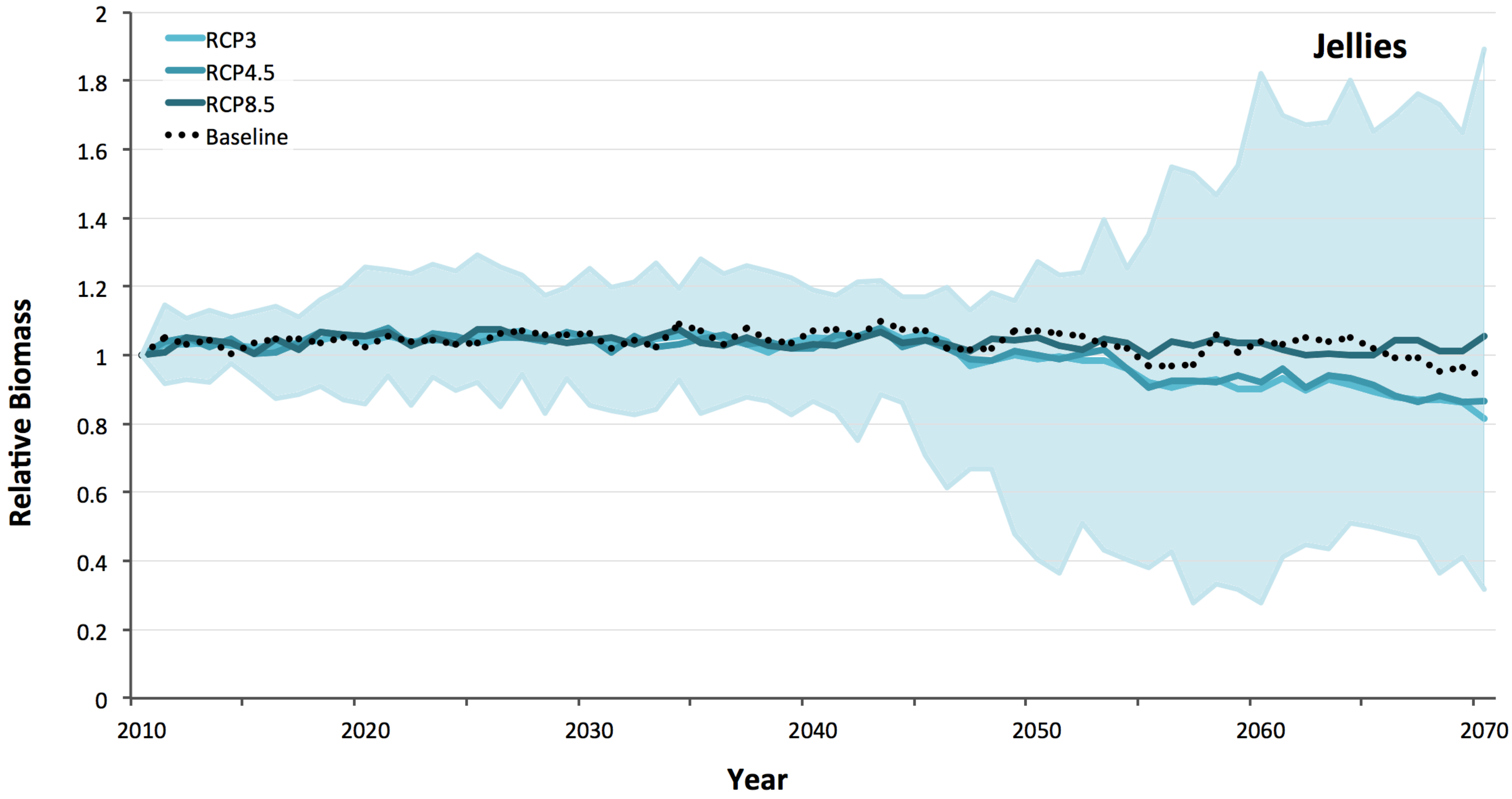


Figure A. 10: The average relative biomass of jellyfish through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

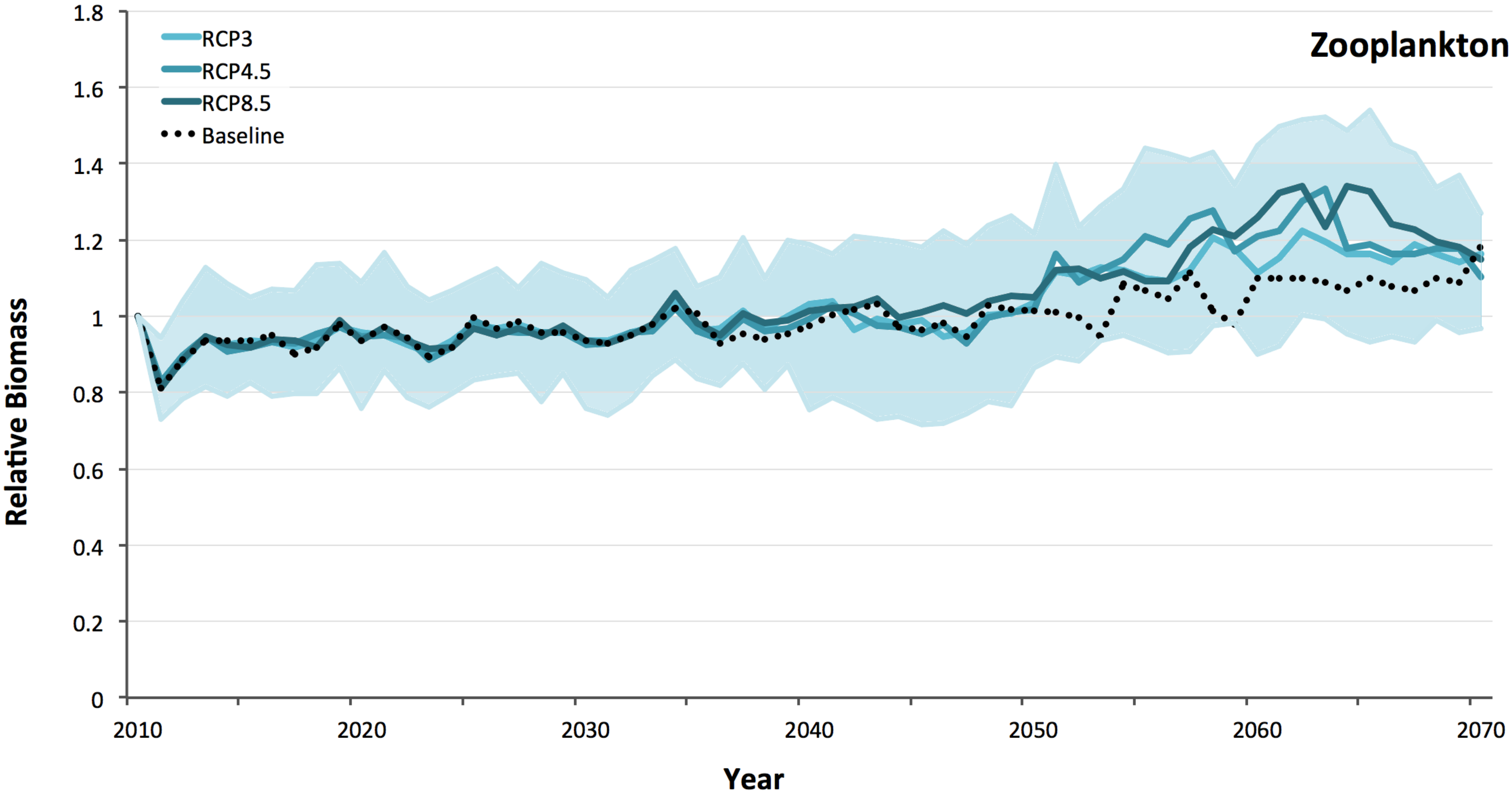


Figure A. 11: The average relative biomass of zooplankton through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

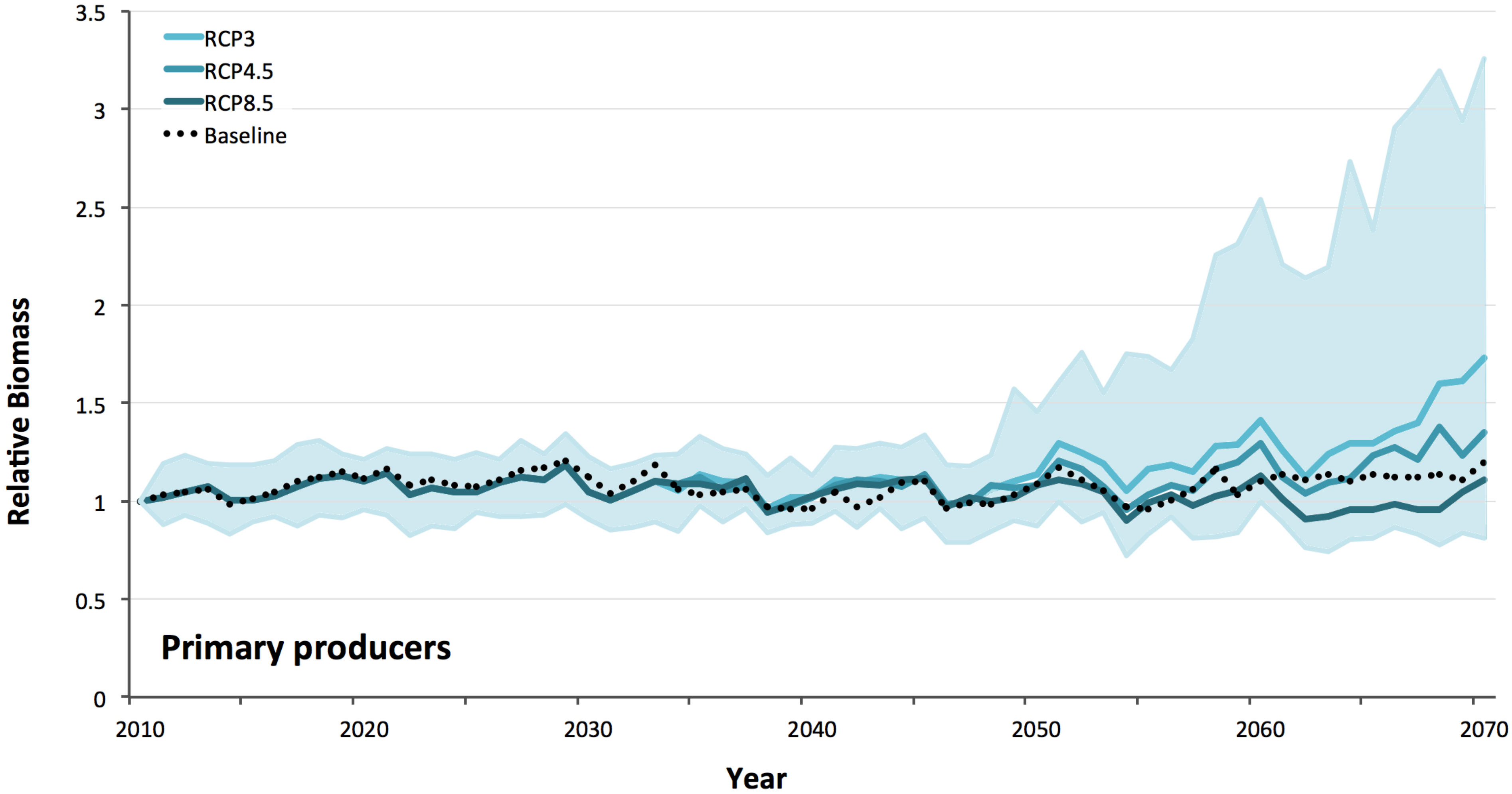


Figure A. 12: The average relative biomass of primary producers through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

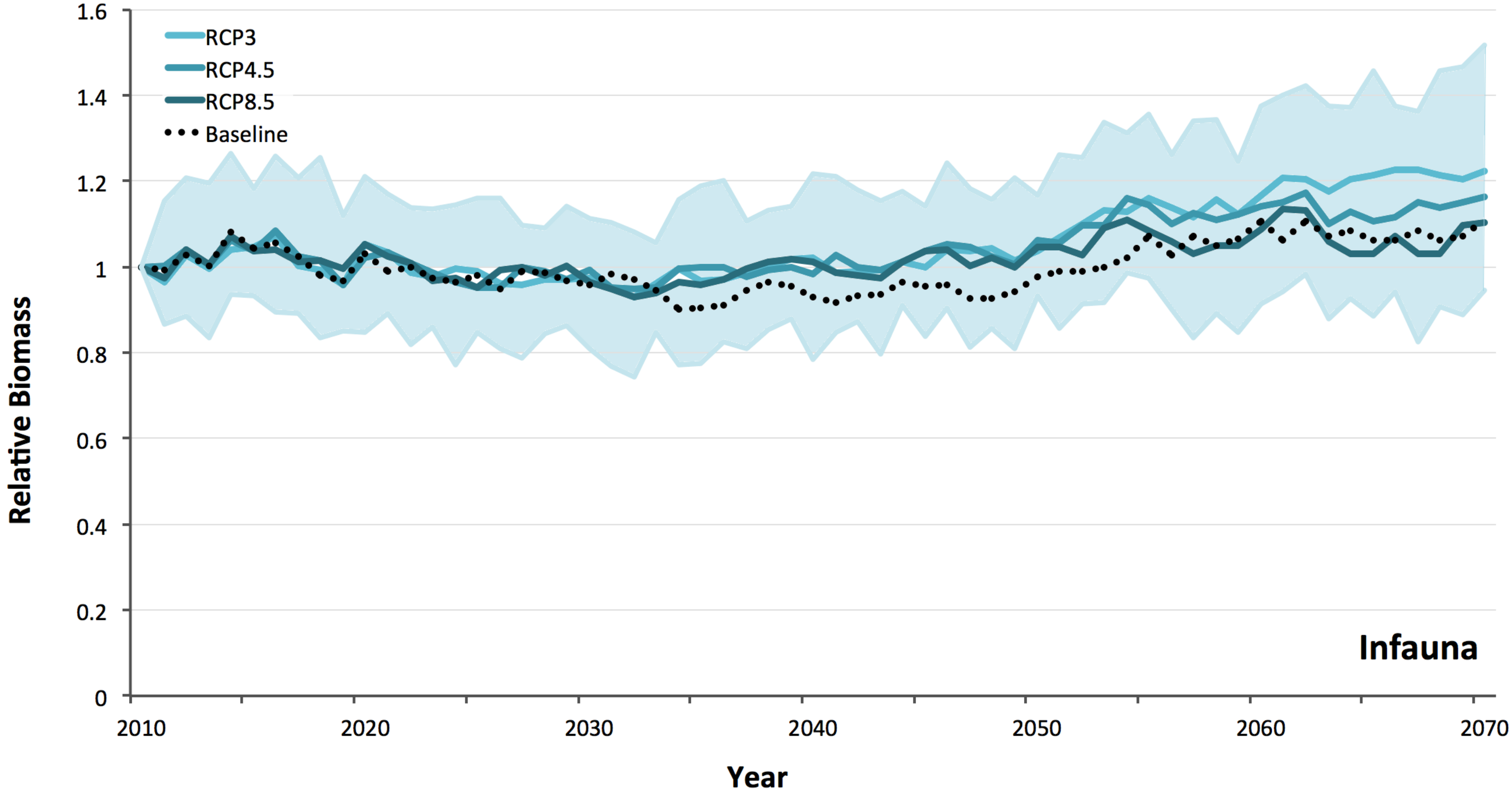


Figure A. 13: The average relative biomass of infauna through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

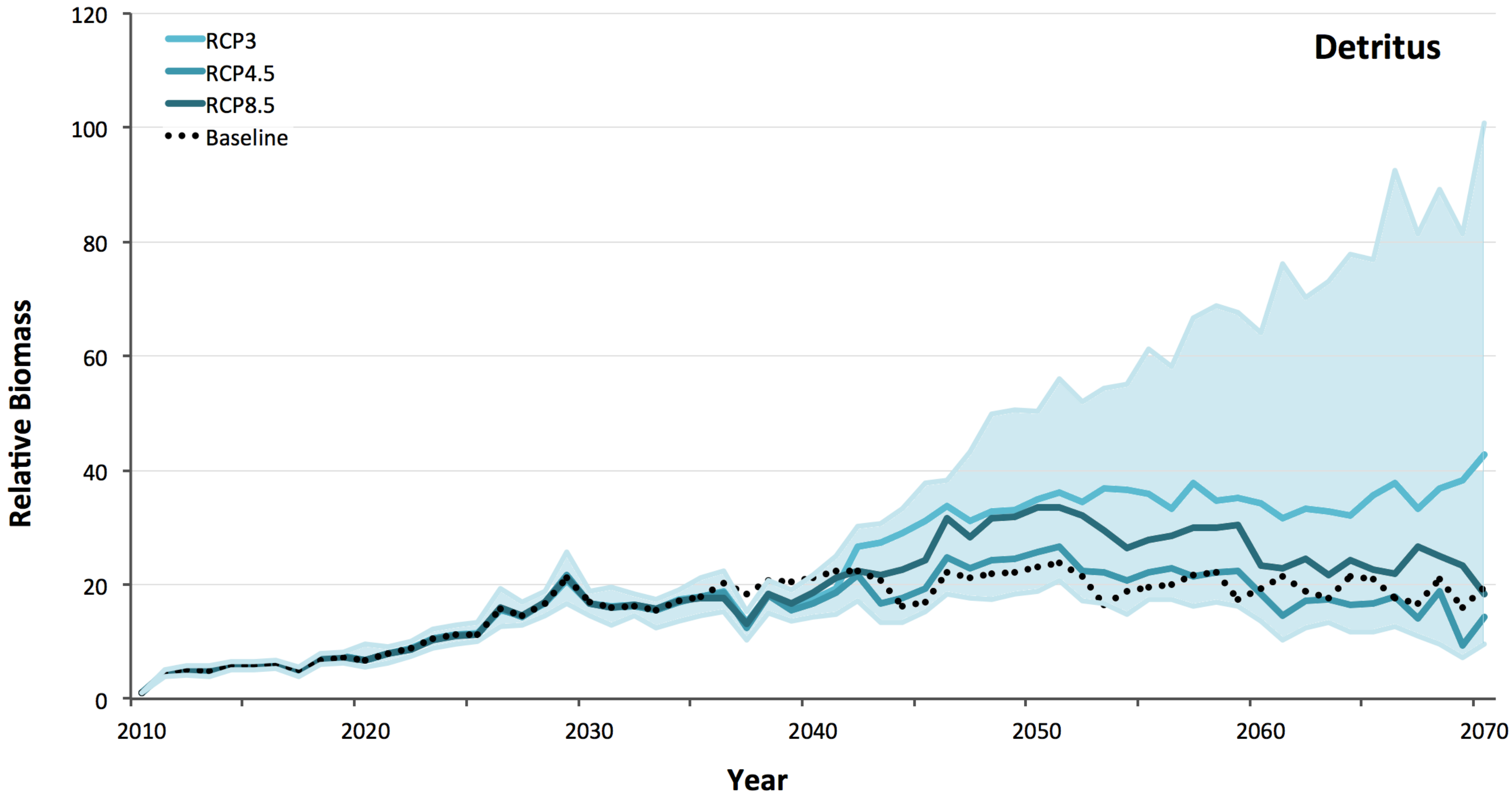


Figure A. 14: The average relative biomass of detritus through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

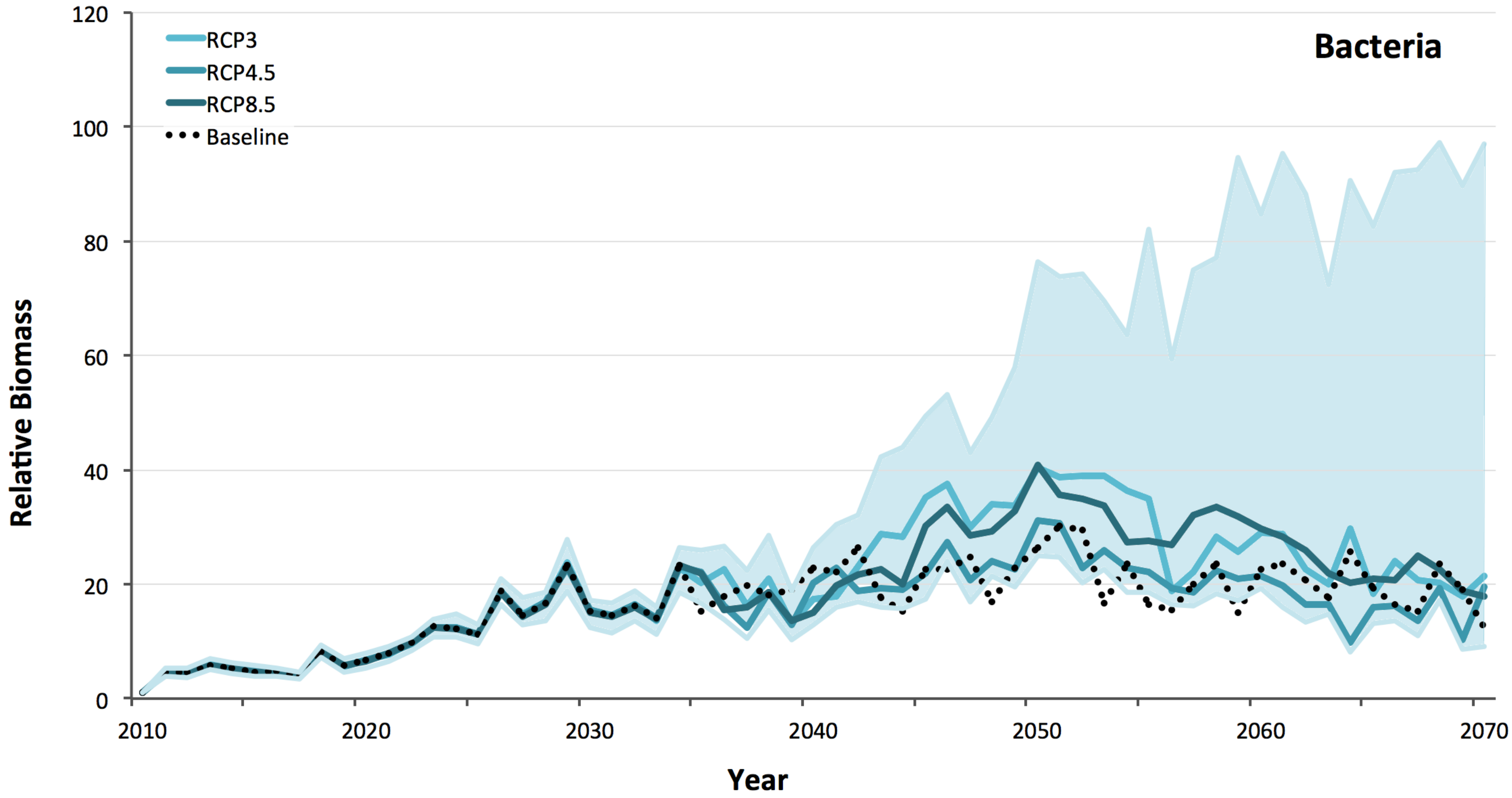


Figure A. 15: The average relative biomass of bacteria through time in Atlantis-SE under the different emission scenarios. The lighter shaded area is the total range.

Atlantis-SEAP

Table A. 7: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SEAP for each strategy-scenario combination under RCP 3. Biomass is relative to 2010 model values.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.76 (± 0.24)	1.55 (± 0.75)	1.5 (± 1.32)	11.24 (± 4.75)	5.87 (± 8.46)	0.39 (± 0.21)	3.03 (± 2.64)	6.43 (± 2.29)
2010 coastal context - Cap ecosystem take	1.9 (± 0.76)	0.86 (± 0.86)	0.64 (± 0.75)	12.22 (± 6.84)	1.72 (± 1.51)	0.26 (± 0.22)	0.93 (± 1.02)	9.43 (± 8.99)
2010 coastal context - Centralised mgmt.	2.42 (± 1.36)	0.96 (± 1.01)	0.64 (± 0.74)	13.77 (± 5.41)	2.49 (± 2.85)	0.51 (± 0.53)	1.64 (± 1.29)	10.49 (± 8.4)
2010 coastal context - FewMPA	2.27 (± 1.24)	0.66 (± 0.55)	0.6 (± 0.76)	12.36 (± 2.99)	1.45 (± 1.38)	0.1 (± 0.09)	0.65 (± 0.81)	9.08 (± 6.03)
2010 coastal context - Fragmented mgmt	2.43 (± 1.39)	0.81 (± 1.02)	0.66 (± 0.78)	13.57 (± 5.35)	2.43 (± 2.65)	0.18 (± 0.17)	0.82 (± 0.87)	10.32 (± 8.29)
2010 coastal context - ManyMPA	2.42 (± 1.38)	0.06 (± 0.03)	0.35 (± 0.41)	14.13 (± 5.77)	0.99 (± 0.93)	0.6 (± 0.65)	3.38 (± 2.82)	10.78 (± 8.8)
2010 coastal context - Seasons	2.41 (± 1.36)	0.46 (± 0.53)	0.36 (± 0.41)	13.81 (± 5.49)	0.97 (± 1.02)	0.6 (± 0.66)	2.32 (± 1.03)	10.51 (± 8.48)
2010 coastal context - SlowAssess	0.93 (± 1.3)	1.21 (± 1.03)	0.24 (± 0.23)	12.58 (± 6.58)	1 (± 0.95)	0.62 (± 0.39)	1.4 (± 0.95)	7.66 (± 10.64)
2010 coastal context - Integrated Mgmt (IM)	0.93 (± 1.47)	0.61 (± 0.28)	0.09 (± 0.09)	14.24 (± 4.37)	1.18 (± 1.29)	2.05 (± 1.32)	3.48 (± 3.57)	9.22 (± 7.63)
Cumulative impacts - 2010 Status Quo (SQ)	0.23 (± 0.1)	1.07 (± 1.15)	0.13 (± 0.16)	8.68 (± 1.79)	0.53 (± 0.43)	0.28 (± 0.18)	2.22 (± 2.98)	1.83 (± 0.56)
Cumulative impacts - Cap ecosystem take	0.21 (± 0.12)	1.4 (± 1.37)	0.13 (± 0.16)	7.7 (± 3.22)	0.41 (± 0.23)	0.2 (± 0.18)	2.16 (± 3.25)	1.64 (± 0.83)
Cumulative impacts - Centralised mgmt.	0.23 (± 0.1)	1.54 (± 1.62)	0.13 (± 0.16)	8.69 (± 1.77)	0.57 (± 0.5)	0.31 (± 0.17)	3.28 (± 4.08)	1.84 (± 0.6)
Cumulative impacts - FewMPA	0.22 (± 0.09)	1.1 (± 0.96)	0.12 (± 0.16)	8.09 (± 2.12)	0.46 (± 0.31)	0.07 (± 0.06)	1.89 (± 2.14)	1.66 (± 0.29)
Cumulative impacts - Fragmented mgmt	0.23 (± 0.1)	1.28 (± 1.61)	0.13 (± 0.17)	8.59 (± 1.93)	0.56 (± 0.45)	0.13 (± 0.09)	2.45 (± 2.89)	1.82 (± 0.59)
Cumulative impacts - ManyMPA	0.23 (± 0.1)	0.08 (± 0.09)	0.07 (± 0.09)	8.91 (± 1.96)	0.22 (± 0.15)	0.38 (± 0.26)	5.52 (± 5.49)	1.89 (± 0.64)
Cumulative impacts - Seasons	0.23 (± 0.1)	0.73 (± 0.84)	0.07 (± 0.09)	8.72 (± 1.87)	0.23 (± 0.17)	0.38 (± 0.24)	3.62 (± 4.03)	1.85 (± 0.61)
Cumulative impacts - SlowAssess	1.72 (± 1.79)	1.69 (± 1.76)	0.48 (± 0.77)	9.91 (± 1.33)	3.04 (± 4.87)	0.13 (± 0.21)	2.57 (± 3.99)	4.62 (± 2.28)
Cumulative impacts - IM	0.79 (± 0.48)	0.72 (± 0.62)	0.2 (± 0.33)	7.79 (± 5.71)	2.3 (± 3.15)	0.65 (± 1.09)	3.93 (± 4.1)	3.53 (± 2.38)
Expanded LTL fishery - IM	2.43 (± 1.39)	1 (± 1.1)	0.62 (± 0.72)	13.71 (± 5.45)	2.6 (± 2.86)	0.29 (± 0.36)	1.77 (± 1.48)	10.44 (± 8.42)
New mesopelgic fishery - IM	2.44 (± 1.39)	0.9 (± 1.15)	0.64 (± 0.75)	13.65 (± 5.51)	2.61 (± 2.85)	0.06 (± 0.09)	1.57 (± 1.27)	10.42 (± 8.44)
Extreme climate events - IM	2.42 (± 1.37)	0.74 (± 0.82)	0.66 (± 0.77)	13.86 (± 5.59)	2.35 (± 2.43)	0.18 (± 0.13)	1.17 (± 1.26)	10.57 (± 8.57)
Blooms - IM	2.41 (± 1.38)	0.68 (± 0.79)	0.66 (± 0.78)	13.74 (± 5.31)	2.47 (± 2.7)	0.46 (± 0.45)	1.19 (± 1.39)	10.46 (± 8.3)
Primary production regime shift - IM	2.44 (± 1.38)	0.98 (± 1.24)	0.65 (± 0.77)	13.51 (± 5.47)	2.3 (± 2.51)	0.22 (± 0.2)	1.99 (± 2.87)	10.32 (± 8.37)
Fish kills - IM	2.41 (± 1.37)	0.73 (± 0.81)	0.65 (± 0.76)	13.85 (± 5.27)	2.31 (± 2.53)	0.2 (± 0.26)	1.26 (± 1.68)	10.51 (± 8.31)
Range extensions - IM	2.42 (± 1.4)	1.2 (± 1.02)	0.64 (± 0.75)	13.39 (± 5.42)	2.43 (± 2.75)	0.27 (± 0.29)	0.94 (± 0.8)	10.24 (± 8.29)
Gear switching allowed - IM	2.41 (± 1.39)	1.43 (± 1.27)	0.35 (± 0.4)	13.92 (± 5.85)	1.22 (± 1.35)	0.58 (± 0.65)	2.79 (± 2.12)	10.67 (± 8.8)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
High compliance - IM	2.42 (± 1.37)	0.82 (± 0.98)	0.63 (± 0.74)	13.67 (± 5.39)	2.49 (± 2.7)	0.46 (± 0.49)	1.97 (± 2.49)	10.39 (± 8.36)
Low Compliance - IM	2.45 (± 1.4)	0.6 (± 0.81)	0.68 (± 0.8)	13.83 (± 5.56)	3.78 (± 4.47)	0.44 (± 0.47)	0.86 (± 1.07)	10.55 (± 8.54)
Flexible fisher behaviour - IM	2.33 (± 1.32)	0.82 (± 0.84)	0.58 (± 0.68)	13.69 (± 5.1)	2.32 (± 2.52)	0.09 (± 0.11)	1.38 (± 0.43)	10.37 (± 8.12)
Increased fishing pressure drivers - IM	2.41 (± 1.37)	0.68 (± 0.71)	0.65 (± 0.75)	13.7 (± 5.16)	2.32 (± 2.53)	0.42 (± 0.46)	1.38 (± 1.77)	10.39 (± 8.17)
High Cost, Low Values - IM	2.41 (± 1.37)	0.29 (± 0.34)	0.35 (± 0.41)	13.99 (± 5.72)	1.2 (± 1.27)	0.62 (± 0.68)	1.34 (± 0.74)	10.67 (± 8.72)
Low Costs, High Values - IM	1.39 (± 0.92)	1.05 (± 1.01)	0.64 (± 0.75)	10.73 (± 8.99)	1.12 (± 0.89)	0.07 (± 0.07)	0.95 (± 1.36)	8.46 (± 10.05)
Standard Markets - IM	2.41 (± 1.37)	0.68 (± 0.71)	0.65 (± 0.75)	13.7 (± 5.16)	2.32 (± 2.53)	0.42 (± 0.43)	1.56 (± 1.96)	10.39 (± 8.17)
Technology Creep - IM	2.38 (± 1.35)	1.06 (± 1.16)	0.48 (± 0.52)	13.85 (± 5.47)	2.34 (± 2.5)	0.05 (± 0.02)	1.4 (± 0.97)	10.53 (± 8.47)
No Acclimation - 2010 coastal context - IM	0.82 (± 0.53)	0.63 (± 0.79)	0.4 (± 0.48)	6.41 (± 5.15)	0.89 (± 0.84)	0.13 (± 0.12)	0.41 (± 0.49)	4.96 (± 5.71)
No Acclimation - Cumulative impacts - SQ	1.15 (± 0.14)	1.22 (± 1.77)	1.14 (± 1.41)	12.06 (± 14.75)	0.74 (± 0.54)	0.1 (± 0.12)	0.23 (± 0.36)	10.81 (± 15.76)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.3 (± 0.27)	0.36 (± 0.08)	4.81 (± 6.1)	0.8 (± 0.7)	9.44 (± 4.72)	7.95 (± 7.11)	1.07 (± 1.24)	4.98 (± 7.79)
2010 coastal context - Cap ecosystem take	0.24 (± 0.05)	0.41 (± 0.58)	0.28 (± 0.12)	0.35 (± 0.33)	8.07 (± 4.6)	3.67 (± 5.85)	0.25 (± 0.24)	2.23 (± 3.79)
2010 coastal context - Centralised mgmt.	0.3 (± 0.11)	0.16 (± 0.05)	0.32 (± 0.16)	0.62 (± 0.47)	9.21 (± 3.82)	5.74 (± 8.53)	0.43 (± 0.36)	3.38 (± 5.63)
2010 coastal context - FewMPA	0.13 (± 0.07)	0.01 (± 0.01)	0.05 (± 0.01)	0.22 (± 0.27)	2.65 (± 1.13)	2.77 (± 4.48)	0.15 (± 0.19)	1.7 (± 2.89)
2010 coastal context - Fragmented mgmt	0.23 (± 0.2)	0.11 (± 0.07)	0.31 (± 0.17)	0.24 (± 0.3)	8.9 (± 4.07)	3.21 (± 4.84)	0.16 (± 0.22)	1.91 (± 3.17)
2010 coastal context - ManyMPA	0.23 (± 0.08)	1.87 (± 2.09)	0.42 (± 0.23)	1.15 (± 0.96)	11.13 (± 4.62)	12.21 (± 18.05)	0.78 (± 0.72)	7.18 (± 11.9)
2010 coastal context - Seasons	0.18 (± 0.11)	1.93 (± 2.22)	0.42 (± 0.24)	0.8 (± 0.43)	11.34 (± 4.57)	6.93 (± 8.95)	0.54 (± 0.38)	3.84 (± 6.12)
2010 coastal context - SlowAssess	0.14 (± 0.05)	0.62 (± 0.81)	4.51 (± 4.81)	0.61 (± 0.25)	13.12 (± 4.1)	6.74 (± 5.03)	0.3 (± 0.25)	2.67 (± 4.56)
2010 coastal context - Integrated Mgmt (IM)	0.19 (± 0.06)	19.66 (± 31.75)	4.93 (± 8.06)	1.38 (± 1.39)	15.18 (± 11.09)	14.94 (± 13.83)	0.54 (± 0.4)	2.84 (± 4.71)
Cumulative impacts - 2010 Status Quo (SQ)	0.18 (± 0.11)	2.06 (± 2.32)	0 (± 0)	0.9 (± 1.18)	5.05 (± 2.38)	7.02 (± 8.68)	0.23 (± 0.29)	0.67 (± 1.13)
Cumulative impacts - Cap ecosystem take	0.17 (± 0.12)	24.5 (± 38.19)	0 (± 0)	0.87 (± 1.29)	4.43 (± 2.37)	6.69 (± 9.57)	0.22 (± 0.32)	0.69 (± 1.19)
Cumulative impacts - Centralised mgmt.	0.21 (± 0.14)	7.22 (± 6.07)	0 (± 0)	1.33 (± 1.61)	5.48 (± 2.7)	10.52 (± 11.84)	0.35 (± 0.39)	0.94 (± 1.58)
Cumulative impacts - FewMPA	0.12 (± 0.14)	0.82 (± 0.55)	0 (± 0)	0.76 (± 0.85)	1.63 (± 0.88)	6.15 (± 6.24)	0.2 (± 0.21)	0.51 (± 0.84)
Cumulative impacts - Fragmented mgmt	0.19 (± 0.13)	6.41 (± 4.78)	0 (± 0)	0.99 (± 1.15)	5.36 (± 2.83)	7.93 (± 8.44)	0.26 (± 0.28)	0.68 (± 1.13)
Cumulative impacts - ManyMPA	0.26 (± 0.26)	104.2 (± 145.46)	0 (± 0)	2.22 (± 2.17)	6.71 (± 3.42)	18.41 (± 16.47)	0.59 (± 0.54)	1.35 (± 2.2)
Cumulative impacts - Seasons	0.18 (± 0.14)	108.19 (± 153.93)	0 (± 0)	1.46 (± 1.59)	6.92 (± 3.62)	11.86 (± 11.77)	0.39 (± 0.39)	0.97 (± 1.6)
Cumulative impacts - SlowAssess	0.19 (± 0.07)	2.13 (± 2.88)	0 (± 0)	1.02 (± 1.6)	4.09 (± 2.84)	7.36 (± 12.27)	0.28 (± 0.38)	0.87 (± 1.42)
Cumulative impacts - IM	0.23 (± 0.21)	70.61 (± 71.17)	0 (± 0)	1.37 (± 1.74)	4.21 (± 3.23)	9.75 (± 13.59)	0.4 (± 0.39)	1.24 (± 1.53)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Expanded LTL fishery - IM	0.24 (± 0.07)	1.34 (± 1.94)	0.36 (± 0.19)	0.61 (± 0.51)	9.64 (± 4)	6.4 (± 9.5)	0.42 (± 0.38)	3.77 (± 6.26)
New mesopelgic fishery - IM	0.26 (± 0.07)	0.4 (± 0.12)	0.38 (± 0.16)	0.53 (± 0.43)	9.82 (± 3.9)	5.62 (± 8.23)	0.36 (± 0.33)	3.29 (± 5.44)
Extreme climate events - IM	0.33 (± 0.17)	0.08 (± 0.08)	0.27 (± 0.13)	0.38 (± 0.42)	8.47 (± 2.97)	4.66 (± 7.26)	0.26 (± 0.31)	2.81 (± 4.72)
Blooms - IM	0.34 (± 0.12)	0.08 (± 0.1)	0.28 (± 0.16)	0.36 (± 0.49)	8.45 (± 3.15)	4.91 (± 7.66)	0.24 (± 0.35)	2.97 (± 4.97)
Primary production regime shift - IM	0.34 (± 0.18)	0.26 (± 0.32)	0.31 (± 0.16)	0.65 (± 0.96)	9.34 (± 4.8)	9.07 (± 15.09)	0.45 (± 0.68)	5.64 (± 9.65)
Fish kills - IM	0.33 (± 0.14)	0.06 (± 0.02)	0.27 (± 0.12)	0.42 (± 0.56)	8.57 (± 3.57)	5.54 (± 9.07)	0.29 (± 0.4)	3.41 (± 5.82)
Range extensions - IM	0.33 (± 0.11)	0.19 (± 0.15)	0.3 (± 0.18)	0.29 (± 0.27)	8.06 (± 3.76)	3.39 (± 4.92)	0.19 (± 0.2)	1.98 (± 3.25)
Gear switching allowed - IM	0.19 (± 0.06)	1.84 (± 2.12)	0.4 (± 0.23)	0.92 (± 0.72)	10.81 (± 4.11)	9.72 (± 13.94)	0.61 (± 0.55)	5.64 (± 9.25)
High compliance - IM	0.32 (± 0.15)	0.21 (± 0.24)	0.28 (± 0.14)	0.76 (± 0.8)	9.09 (± 4.3)	8.28 (± 13.63)	0.54 (± 0.56)	5.1 (± 8.76)
Low Compliance - IM	0.26 (± 0.11)	0.12 (± 0.17)	0.23 (± 0.14)	0.29 (± 0.35)	7.93 (± 3.38)	3.66 (± 5.9)	0.2 (± 0.25)	2.24 (± 3.8)
Flexible fisher behaviour - IM	0.28 (± 0.18)	0.28 (± 0.25)	0.34 (± 0.18)	0.53 (± 0.34)	9.36 (± 3.7)	3.82 (± 4.78)	0.37 (± 0.29)	2.08 (± 3.31)
Increased fishing pressure drivers - IM	0.24 (± 0.06)	0.23 (± 0.27)	0.26 (± 0.11)	0.48 (± 0.58)	8.5 (± 3.23)	5.94 (± 9.68)	0.33 (± 0.41)	3.65 (± 6.23)
High Cost, Low Values - IM	0.07 (± 0.09)	2 (± 2.3)	0.44 (± 0.26)	0.38 (± 0.1)	11.47 (± 4.65)	3.41 (± 3.58)	0.24 (± 0.12)	1.73 (± 2.54)
Low Costs, High Values - IM	0.14 (± 0.07)	0.77 (± 1.14)	0.29 (± 0.14)	0.35 (± 0.43)	7.64 (± 6.04)	4.26 (± 7.17)	0.25 (± 0.3)	2.66 (± 4.58)
Standard Markets - IM	0.31 (± 0.14)	0.06 (± 0.03)	0.26 (± 0.11)	0.55 (± 0.64)	8.5 (± 3.23)	6.63 (± 10.81)	0.38 (± 0.45)	4.07 (± 6.95)
Technology Creep - IM	0.19 (± 0.04)	1.67 (± 1.84)	0.41 (± 0.23)	0.39 (± 0.27)	10.39 (± 3.91)	4.34 (± 5.49)	0.24 (± 0.22)	2.39 (± 3.73)
No Acclimation - 2010 coastal context - IM	0.18 (± 0.09)	0.02 (± 0.03)	0.1 (± 0.07)	0.14 (± 0.16)	5.68 (± 6.09)	1.7 (± 2.72)	0.1 (± 0.12)	1.04 (± 1.76)
No Acclimation - Cumulative impacts - SQ	0.43 (± 0.4)	0.01 (± 0.01)	3.41 (± 5.81)	0.08 (± 0.12)	4.35 (± 5.5)	1.09 (± 1.85)	0.06 (± 0.08)	0.68 (± 1.18)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	6.3 (± 7.06)	0.72 (± 0.58)	7.12 (± 6.95)	1.03 (± 1.04)	3.61 (± 5.81)	27.1 (± 11.01)	3.24 (± 0.31)	2.13 (± 0.03)
2010 coastal context - Cap ecosystem take	3.39 (± 4.35)	0.83 (± 0.84)	3.06 (± 4.58)	0.76 (± 0.88)	5.49 (± 7.23)	40.04 (± 51.11)	1.25 (± 0.93)	1.83 (± 0.55)
2010 coastal context - Centralised mgmt.	5.53 (± 6.2)	1.58 (± 1.79)	4.84 (± 6.62)	1.26 (± 1.25)	6.53 (± 7.22)	42.37 (± 49.99)	1.26 (± 0.93)	1.86 (± 0.58)
2010 coastal context - FewMPA	2.34 (± 3.48)	0.37 (± 0.31)	2.24 (± 3.56)	0.5 (± 0.71)	3.19 (± 3.44)	35.31 (± 37.8)	1.18 (± 0.87)	1.34 (± 0.4)
2010 coastal context - Fragmented mgmt	2.56 (± 3.87)	0.29 (± 0.32)	2.55 (± 3.89)	0.54 (± 0.8)	6.47 (± 7.36)	41.77 (± 49.34)	1.25 (± 0.92)	1.78 (± 0.54)
2010 coastal context - ManyMPA	10.9 (± 13.53)	2.42 (± 2.25)	10.03 (± 14.19)	2.43 (± 2.72)	1.49 (± 1.6)	43.77 (± 52.12)	1.06 (± 0.77)	1.41 (± 0.32)
2010 coastal context - Seasons	6.68 (± 6.34)	2.04 (± 2.37)	5.81 (± 6.9)	1.55 (± 1.26)	2.28 (± 2.72)	42.56 (± 50.37)	0.99 (± 0.73)	1.42 (± 0.41)
2010 coastal context - SlowAssess	3.91 (± 5.29)	0.53 (± 0.34)	5.34 (± 4.26)	0.72 (± 1.18)	5.31 (± 8.41)	44.57 (± 47.79)	0.87 (± 1.05)	1.43 (± 0.62)
2010 coastal context - Integrated Mgmt (IM)	6.1 (± 5.15)	1.13 (± 1.01)	9.13 (± 6.44)	0.83 (± 1.18)	1.81 (± 3.02)	44.27 (± 47.41)	1.58 (± 1.37)	1.34 (± 0.32)
Cumulative impacts - 2010 Status Quo (SQ)	3.15 (± 4.6)	0.58 (± 0.73)	3.04 (± 3.27)	0.11 (± 0.15)	3.78 (± 5.95)	19.52 (± 4.62)	0.24 (± 0.14)	0.94 (± 0.13)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
Cumulative impacts - Cap ecosystem take	3.14 (± 4.95)	0.56 (± 0.8)	2.84 (± 3.68)	0.11 (± 0.16)	4.08 (± 6.55)	17.11 (± 7.29)	0.24 (± 0.14)	0.92 (± 0.16)
Cumulative impacts - Centralised mgmt.	4.59 (± 6.32)	0.86 (± 0.99)	4.58 (± 4.48)	0.16 (± 0.21)	4.36 (± 6.82)	19.6 (± 4.95)	0.24 (± 0.14)	0.94 (± 0.17)
Cumulative impacts - FewMPA	2.59 (± 3.33)	0.5 (± 0.52)	2.7 (± 2.39)	0.09 (± 0.11)	2.13 (± 3.26)	17.81 (± 2.06)	0.22 (± 0.13)	0.67 (± 0.11)
Cumulative impacts - Fragmented mgmt	3.4 (± 4.49)	0.64 (± 0.71)	3.45 (± 3.24)	0.12 (± 0.15)	4.37 (± 6.92)	19.3 (± 4.86)	0.24 (± 0.14)	0.9 (± 0.16)
Cumulative impacts - ManyMPA	7.37 (± 8.47)	1.48 (± 1.36)	8.22 (± 6.6)	0.26 (± 0.28)	1 (± 1.52)	20.07 (± 5.34)	0.2 (± 0.12)	0.72 (± 0.06)
Cumulative impacts - Seasons	4.96 (± 6.27)	0.96 (± 0.98)	5.23 (± 4.52)	0.17 (± 0.21)	1.6 (± 2.53)	19.63 (± 5.03)	0.19 (± 0.11)	0.72 (± 0.11)
Cumulative impacts - SlowAssess	3.9 (± 5.95)	0.83 (± 0.89)	3.05 (± 4.81)	0.21 (± 0.15)	5.68 (± 6.37)	17.39 (± 6.74)	0.65 (± 0.7)	1.28 (± 0.42)
Cumulative impacts - IM	5.42 (± 6.28)	1.25 (± 0.96)	4.39 (± 5.06)	0.45 (± 0.05)	1.58 (± 2.52)	11.56 (± 4.85)	1.66 (± 1.27)	1.25 (± 0.4)
Expanded LTL fishery - IM	5.77 (± 7.09)	1.33 (± 1.28)	5.28 (± 7.46)	1.29 (± 1.42)	6.89 (± 7.61)	42.26 (± 50.01)	1.27 (± 0.93)	1.86 (± 0.59)
New mesopelgic fishery - IM	5 (± 6.17)	1.11 (± 1.03)	4.61 (± 6.47)	1.11 (± 1.24)	6.92 (± 7.57)	42.19 (± 50.07)	1.26 (± 0.93)	1.79 (± 0.53)
Extreme climate events - IM	3.94 (± 5.62)	0.65 (± 0.52)	3.77 (± 5.76)	0.85 (± 1.15)	5.9 (± 6.57)	42.84 (± 50.84)	1.23 (± 0.9)	1.85 (± 0.53)
Blooms - IM	3.92 (± 6.13)	0.42 (± 0.51)	3.91 (± 6.14)	0.83 (± 1.27)	6.02 (± 6.51)	42.13 (± 49.49)	1.22 (± 0.89)	1.85 (± 0.49)
Primary production regime shift - IM	7.39 (± 11.95)	0.87 (± 0.98)	7.28 (± 12.05)	1.56 (± 2.47)	7.18 (± 8.76)	41.79 (± 49.63)	1.29 (± 0.98)	1.82 (± 0.5)
Fish kills - IM	4.59 (± 7.12)	0.63 (± 0.58)	4.47 (± 7.22)	0.98 (± 1.46)	5.83 (± 6.7)	42.36 (± 49.62)	1.23 (± 0.9)	1.85 (± 0.5)
Range extensions - IM	2.86 (± 3.79)	0.5 (± 0.38)	2.74 (± 3.91)	0.63 (± 0.77)	6.2 (± 6.73)	41.4 (± 49.12)	1.54 (± 1.15)	2.27 (± 1.07)
Gear switching allowed - IM	8.59 (± 10.46)	1.86 (± 1.69)	7.95 (± 10.97)	1.91 (± 2.09)	2.63 (± 3.16)	43.36 (± 51.94)	1.27 (± 0.94)	1.62 (± 0.48)
High compliance - IM	7.54 (± 10.24)	1.69 (± 1.65)	6.88 (± 10.7)	1.67 (± 2.08)	6.37 (± 7.84)	42.07 (± 49.71)	1.27 (± 0.94)	1.82 (± 0.51)
Low Compliance - IM	3.09 (± 4.58)	0.49 (± 0.41)	2.96 (± 4.69)	0.67 (± 0.94)	7.57 (± 8.24)	42.71 (± 50.66)	1.24 (± 0.92)	1.83 (± 0.49)
Flexible fisher behaviour - IM	4.12 (± 3.34)	1.62 (± 2.17)	3.33 (± 3.6)	0.99 (± 0.72)	6.51 (± 7.1)	41.7 (± 48.62)	1.26 (± 0.92)	1.84 (± 0.53)
Increased fishing pressure drivers - IM	5.06 (± 7.49)	0.83 (± 0.7)	4.83 (± 7.68)	1.09 (± 1.53)	5.6 (± 6.31)	41.81 (± 48.85)	1.23 (± 0.9)	1.86 (± 0.5)
High Cost, Low Values - IM	3.07 (± 2.45)	0.83 (± 0.87)	2.77 (± 2.74)	0.71 (± 0.46)	1.53 (± 1.76)	43.36 (± 51.65)	1.02 (± 0.75)	1.4 (± 0.37)
Low Costs, High Values - IM	3.72 (± 5.49)	0.68 (± 0.6)	3.5 (± 5.66)	0.81 (± 1.12)	5.39 (± 8.28)	38.26 (± 53.53)	1.27 (± 0.97)	1.8 (± 0.59)
Standard Markets - IM	5.72 (± 8.31)	1.01 (± 0.86)	5.41 (± 8.55)	1.24 (± 1.69)	5.6 (± 6.31)	41.81 (± 48.85)	1.23 (± 0.9)	1.86 (± 0.5)
Technology Creep - IM	3.6 (± 4.2)	0.63 (± 0.45)	3.46 (± 4.36)	0.79 (± 0.84)	6.78 (± 7.58)	42.65 (± 50.41)	1.29 (± 0.95)	1.71 (± 0.48)
No Acclimation - 2010 coastal context - IM	1.45 (± 2.1)	0.24 (± 0.2)	1.38 (± 2.16)	0.31 (± 0.43)	4.62 (± 7.3)	22.27 (± 30.54)	0.12 (± 0.09)	0.79 (± 1.14)
No Acclimation - Cumulative impacts - SQ	0.9 (± 1.46)	0.11 (± 0.12)	0.88 (± 1.48)	0.19 (± 0.3)	15.59 (± 15.29)	51.31 (± 81.19)	0.06 (± 0.05)	0.76 (± 1.09)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
No Climate change - 2010 context - SQ	6.24 (± 4.77)	0.54 (± 0.06)	1.81 (± 0.96)	0.41 (± 0.06)	6.2 (± 0.18)	1.62 (± 0.96)	0.99 (± 0.43)	0.51 (± 0.17)
2010 coastal context - Cap ecosystem take	121.6 (± 158.7)	0.62 (± 0.43)	20.96 (± 27.33)	0.49 (± 0.6)	1.73 (± 1.93)	0.25 (± 0.04)	0.98 (± 0.17)	0.04 (± 0.01)
2010 coastal context - Centralised mgmt.	140.54 (± 189.79)	0.63 (± 0.43)	18.48 (± 24.24)	0.48 (± 0.55)	2.06 (± 2.33)	0.21 (± 0.09)	0.89 (± 0.34)	0.03 (± 0.01)
2010 coastal context - FewMPA	84.85 (± 98.66)	0.61 (± 0.41)	3.21 (± 2.63)	0.01 (± 0.01)	1.85 (± 2.27)	0.21 (± 0.08)	0.58 (± 0.23)	0.03 (± 0.01)
2010 coastal context - Fragmented mgmt	134.46 (± 188.62)	0.63 (± 0.43)	33.53 (± 50.2)	0.47 (± 0.56)	1.97 (± 2.23)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
2010 coastal context - ManyMPA	98.45 (± 168.39)	0.64 (± 0.43)	4.12 (± 5.36)	0.48 (± 0.55)	1.73 (± 1.94)	0.22 (± 0.09)	0.9 (± 0.34)	0.03 (± 0.01)
2010 coastal context - Seasons	30.49 (± 38.12)	0.64 (± 0.44)	0.97 (± 0.65)	0.6 (± 0.76)	1.6 (± 1.78)	0.22 (± 0.09)	0.9 (± 0.33)	0.03 (± 0.01)
2010 coastal context - SlowAssess	12.54 (± 10.09)	0.66 (± 0.39)	3.52 (± 4.43)	0.79 (± 1.07)	2.38 (± 2.47)	0.79 (± 0.5)	0.9 (± 0.36)	0.01 (± 0.02)
2010 coastal context - Integrated Mgmt (IM)	2.46 (± 3.02)	0.65 (± 0.28)	1.07 (± 1.19)	0.22 (± 0.19)	6.75 (± 5.75)	7.43 (± 10.71)	0.98 (± 0.34)	0.06 (± 0.1)
Cumulative impacts - 2010 Status Quo (SQ)	5.97 (± 3.42)	0.62 (± 0.33)	1.25 (± 1.84)	0.22 (± 0.23)	3.6 (± 2.26)	0.75 (± 0.28)	0.6 (± 0.23)	0 (± 0)
Cumulative impacts - Cap ecosystem take	5.93 (± 3.11)	0.61 (± 0.34)	1.15 (± 1.75)	0.22 (± 0.23)	3.21 (± 1.79)	1.05 (± 0.7)	0.67 (± 0.11)	0 (± 0)
Cumulative impacts - Centralised mgmt.	6.64 (± 3.71)	0.62 (± 0.33)	1.02 (± 1.55)	0.22 (± 0.21)	3.73 (± 2.08)	0.76 (± 0.28)	0.61 (± 0.23)	0 (± 0)
Cumulative impacts - FewMPA	4.47 (± 1.91)	0.61 (± 0.32)	0.5 (± 0.84)	0 (± 0)	3.34 (± 2.2)	0.75 (± 0.29)	0.4 (± 0.16)	0 (± 0)
Cumulative impacts - Fragmented mgmt	6.25 (± 3.92)	0.62 (± 0.33)	1.93 (± 3.12)	0.21 (± 0.22)	3.81 (± 2.47)	0.76 (± 0.29)	0.61 (± 0.23)	0 (± 0)
Cumulative impacts - ManyMPA	2.31 (± 3.72)	0.63 (± 0.34)	0.13 (± 0.13)	0.22 (± 0.21)	3.26 (± 1.92)	0.77 (± 0.29)	0.62 (± 0.23)	0 (± 0)
Cumulative impacts - Seasons	1.58 (± 0.82)	0.64 (± 0.34)	0.04 (± 0.06)	0.27 (± 0.29)	2.95 (± 1.6)	0.78 (± 0.29)	0.62 (± 0.23)	0 (± 0)
Cumulative impacts - SlowAssess	103.29 (± 136.9)	0.6 (± 0.36)	2.3 (± 3.43)	0.49 (± 0.7)	2.69 (± 2.56)	0.53 (± 0.41)	0.62 (± 0.25)	0.04 (± 0.04)
Cumulative impacts - IM	12.19 (± 16.53)	0.59 (± 0.27)	1.28 (± 2.07)	0.13 (± 0.12)	12.3 (± 15.99)	2.87 (± 2.91)	0.57 (± 0.26)	0.16 (± 0.21)
Expanded LTL fishery - IM	129.57 (± 168.81)	0.64 (± 0.43)	13.51 (± 17.41)	0.55 (± 0.66)	1.63 (± 2.01)	0.21 (± 0.09)	0.9 (± 0.34)	0.03 (± 0.01)
New mesopelgic fishery - IM	126 (± 171.78)	0.63 (± 0.43)	17.17 (± 23.75)	0.55 (± 0.65)	1.66 (± 2.05)	0.21 (± 0.09)	0.9 (± 0.34)	0.03 (± 0.01)
Extreme climate events - IM	147.02 (± 209.52)	0.63 (± 0.42)	27.12 (± 34.69)	0.53 (± 0.65)	1.54 (± 1.55)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
Blooms - IM	144.05 (± 209.12)	0.63 (± 0.42)	31.92 (± 43.35)	0.48 (± 0.57)	1.33 (± 1.24)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
Primary production regime shift - IM	144.9 (± 200.4)	0.64 (± 0.44)	25.8 (± 40.4)	0.58 (± 0.52)	1.33 (± 1.36)	0.28 (± 0.15)	0.9 (± 0.36)	0.04 (± 0.01)
Fish kills - IM	144.02 (± 204.65)	0.63 (± 0.43)	25.34 (± 32.58)	0.45 (± 0.51)	1.91 (± 2.19)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
Range extensions - IM	147.32 (± 170.65)	0.73 (± 0.41)	51.94 (± 79.62)	0.75 (± 1.02)	2.44 (± 3.12)	0.21 (± 0.09)	0.84 (± 0.3)	0.03 (± 0.01)
Gear switching allowed - IM	130.7 (± 159.23)	0.65 (± 0.44)	3.15 (± 3.43)	0.51 (± 0.61)	1.58 (± 1.8)	0.22 (± 0.09)	0.89 (± 0.33)	0.03 (± 0.01)
High compliance - IM	142.71 (± 192.83)	0.63 (± 0.43)	20.78 (± 28.07)	0.54 (± 0.65)	2.42 (± 3.14)	0.21 (± 0.09)	0.88 (± 0.34)	0.03 (± 0.01)
Low Compliance - IM	98.33 (± 133.02)	0.62 (± 0.42)	40.29 (± 58.12)	0.41 (± 0.46)	1.61 (± 1.91)	0.21 (± 0.08)	0.87 (± 0.33)	0.03 (± 0.01)
Flexible fisher behaviour - IM	143.64 (± 198.26)	0.63 (± 0.43)	15.37 (± 19.42)	0.48 (± 0.57)	1.69 (± 1.8)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
Increased fishing pressure drivers - IM	143.9 (± 204.8)	0.63 (± 0.42)	23.26 (± 28.51)	0.49 (± 0.6)	1.97 (± 2.33)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
High Cost, Low Values - IM	10.49 (± 9.89)	0.64 (± 0.44)	0.24 (± 0.37)	0.42 (± 0.48)	1.4 (± 1.38)	0.22 (± 0.09)	0.9 (± 0.33)	0.03 (± 0.01)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
Low Costs, High Values - IM	99.3 (± 112.69)	0.62 (± 0.44)	18.67 (± 26.16)	0.5 (± 0.59)	1.49 (± 1.53)	0.29 (± 0.07)	1.08 (± 0.01)	0.05 (± 0.02)
Standard Markets - IM	143.9 (± 204.8)	0.63 (± 0.42)	23.26 (± 28.51)	0.49 (± 0.6)	1.97 (± 2.33)	0.21 (± 0.09)	0.88 (± 0.33)	0.03 (± 0.01)
Technology Creep - IM	135.06 (± 181.41)	0.64 (± 0.43)	5.7 (± 8.65)	0.44 (± 0.51)	2.35 (± 3.03)	0.22 (± 0.09)	0.9 (± 0.34)	0.03 (± 0.01)
No Acclimation - 2010 coastal context - IM	21.77 (± 18.44)	0.2 (± 0.25)	10.98 (± 16.22)	0.39 (± 0.66)	3.35 (± 4.44)	0.1 (± 0.05)	0.13 (± 0)	0.02 (± 0.01)
No Acclimation - Cumulative impacts - SQ	165.85 (± 139.66)	0.2 (± 0.25)	57.51 (± 92.72)	1.05 (± 1.8)	1.25 (± 1.73)	0.03 (± 0.03)	0.13 (± 0.03)	0 (± 0)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
No Climate change - 2010 context - SQ	0.52 (± 0.39)	1.34 (± 0.04)	1.1 (± 0.13)	0.15 (± 0.07)	1.35 (± 0.21)	0.88 (± 0.03)	0.46 (± 0.08)	2.01 (± 0.11)
2010 coastal context - Cap ecosystem take	1.34 (± 1.38)	1.55 (± 0.44)	0.91 (± 0.24)	0.1 (± 0.07)	0.83 (± 0.64)	1.67 (± 1.37)	0.3 (± 0.11)	1.08 (± 0.42)
2010 coastal context - Centralised mgmt.	1.26 (± 1.45)	1.3 (± 0.11)	0.78 (± 0.12)	0.1 (± 0.08)	0.85 (± 0.93)	1.69 (± 1.37)	0.25 (± 0.14)	1.02 (± 0.56)
2010 coastal context - FewMPA	1.13 (± 1.15)	1.33 (± 0.1)	0.37 (± 0.05)	0.07 (± 0.06)	0.01 (± 0.01)	1.1 (± 0.87)	0.25 (± 0.14)	0.77 (± 0.42)
2010 coastal context - Fragmented mgmt	1.16 (± 1.21)	1.31 (± 0.11)	0.77 (± 0.15)	0.1 (± 0.08)	0.67 (± 0.16)	1.66 (± 1.33)	0.25 (± 0.14)	1.01 (± 0.55)
2010 coastal context - ManyMPA	1.08 (± 1.01)	1.3 (± 0.11)	0.9 (± 0.14)	0.1 (± 0.09)	6.78 (± 2.92)	1.74 (± 1.4)	0.25 (± 0.14)	1.06 (± 0.58)
2010 coastal context - Seasons	1.12 (± 1.23)	1.31 (± 0.11)	0.9 (± 0.14)	0.1 (± 0.08)	6.79 (± 2.97)	1.73 (± 1.4)	0.25 (± 0.14)	1.05 (± 0.57)
2010 coastal context - SlowAssess	1.07 (± 1.06)	1.26 (± 0.14)	1.39 (± 0.59)	0.1 (± 0.08)	6.15 (± 6.11)	2.19 (± 2.02)	0.34 (± 0.21)	1.73 (± 1.33)
2010 coastal context - Integrated Mgmt (IM)	1.38 (± 1.48)	1.23 (± 0.2)	1.8 (± 0.87)	0.12 (± 0.1)	6.59 (± 4.38)	1.45 (± 1.04)	0.66 (± 0.11)	1.95 (± 1.45)
Cumulative impacts - 2010 Status Quo (SQ)	1.65 (± 1.34)	1.24 (± 0.07)	0.93 (± 0.13)	0.05 (± 0.03)	1.16 (± 1.19)	1.51 (± 0.85)	0.49 (± 0.2)	1.54 (± 0.92)
Cumulative impacts - Cap ecosystem take	1.83 (± 1.39)	1.47 (± 0.43)	1.13 (± 0.18)	0.06 (± 0.03)	3.23 (± 2.82)	1.81 (± 0.64)	0.57 (± 0.06)	1.65 (± 0.75)
Cumulative impacts - Centralised mgmt.	1.71 (± 1.42)	1.23 (± 0.07)	0.98 (± 0.13)	0.05 (± 0.03)	3.83 (± 4.35)	1.53 (± 0.85)	0.49 (± 0.2)	1.57 (± 0.93)
Cumulative impacts - FewMPA	1.61 (± 1.29)	1.26 (± 0.06)	0.46 (± 0.04)	0.04 (± 0.02)	7.69 (± 7.63)	1 (± 0.54)	0.49 (± 0.2)	1.18 (± 0.7)
Cumulative impacts - Fragmented mgmt	1.6 (± 1.25)	1.24 (± 0.07)	0.96 (± 0.13)	0.05 (± 0.03)	32.45 (± 54.05)	1.51 (± 0.82)	0.49 (± 0.2)	1.55 (± 0.92)
Cumulative impacts - ManyMPA	1.62 (± 1.33)	1.23 (± 0.07)	1.13 (± 0.12)	0.05 (± 0.03)	10.9 (± 9.17)	1.58 (± 0.86)	0.49 (± 0.2)	1.64 (± 0.97)
Cumulative impacts - Seasons	1.54 (± 1.24)	1.24 (± 0.07)	1.13 (± 0.11)	0.05 (± 0.03)	8.79 (± 7.52)	1.57 (± 0.86)	0.49 (± 0.2)	1.62 (± 0.96)
Cumulative impacts - SlowAssess	1.56 (± 1.14)	1.29 (± 0.03)	0.67 (± 0.34)	0.06 (± 0.03)	2.47 (± 4.28)	1.77 (± 1.48)	0.39 (± 0.23)	1.18 (± 0.92)
Cumulative impacts - IM	0.46 (± 0.46)	0.91 (± 0.5)	0.83 (± 0.36)	0.06 (± 0.04)	4.62 (± 4.31)	1.09 (± 0.82)	0.98 (± 0.92)	1.38 (± 1.17)
Expanded LTL fishery - IM	1.38 (± 1.56)	1.32 (± 0.1)	0.82 (± 0.13)	0.1 (± 0.08)	4.5 (± 4.78)	1.71 (± 1.39)	0.25 (± 0.14)	1.04 (± 0.56)
New mesopelgic fishery - IM	1.42 (± 1.63)	1.31 (± 0.11)	0.83 (± 0.12)	0.1 (± 0.08)	6.09 (± 4.6)	1.73 (± 1.42)	0.25 (± 0.14)	1.04 (± 0.57)
Extreme climate events - IM	0.97 (± 0.94)	1.31 (± 0.11)	0.74 (± 0.08)	0.1 (± 0.08)	2.04 (± 2.31)	1.66 (± 1.36)	0.25 (± 0.14)	1 (± 0.54)
Blooms - IM	1.09 (± 1.15)	1.3 (± 0.11)	0.74 (± 0.1)	0.1 (± 0.08)	2.41 (± 3.3)	1.66 (± 1.34)	0.25 (± 0.14)	0.99 (± 0.53)
Primary production regime shift - IM	1 (± 1.12)	1.31 (± 0.12)	0.81 (± 0.23)	0.11 (± 0.1)	2.46 (± 1.11)	1.79 (± 1.27)	0.25 (± 0.14)	1.08 (± 0.63)
Fish kills - IM	1.13 (± 1.26)	1.3 (± 0.11)	0.75 (± 0.11)	0.1 (± 0.08)	1.18 (± 0.84)	1.66 (± 1.36)	0.25 (± 0.14)	1 (± 0.55)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
Range extensions - IM	0.96 (± 0.94)	1.26 (± 0.18)	0.72 (± 0.15)	0.1 (± 0.08)	2.99 (± 3.42)	1.68 (± 1.38)	0.25 (± 0.14)	1 (± 0.54)
Gear switching allowed - IM	1.01 (± 1.1)	1.3 (± 0.11)	0.9 (± 0.13)	0.1 (± 0.08)	6.77 (± 2.95)	1.73 (± 1.4)	0.25 (± 0.14)	1.04 (± 0.56)
High compliance - IM	1.19 (± 1.22)	1.3 (± 0.11)	0.76 (± 0.16)	0.1 (± 0.08)	1.08 (± 0.66)	1.68 (± 1.38)	0.25 (± 0.14)	1.02 (± 0.57)
Low Compliance - IM	1.06 (± 1.1)	1.31 (± 0.11)	0.7 (± 0.13)	0.09 (± 0.08)	0.6 (± 0.88)	1.6 (± 1.26)	0.25 (± 0.14)	0.96 (± 0.52)
Flexible fisher behaviour - IM	0.86 (± 0.93)	1.3 (± 0.11)	0.79 (± 0.11)	0.1 (± 0.08)	4.3 (± 5.27)	1.69 (± 1.37)	0.25 (± 0.14)	1.02 (± 0.55)
Increased fishing pressure drivers - IM	1.17 (± 1.25)	1.31 (± 0.11)	0.74 (± 0.1)	0.1 (± 0.08)	1.22 (± 0.93)	1.66 (± 1.37)	0.25 (± 0.14)	1 (± 0.54)
High Cost, Low Values - IM	1.11 (± 1.09)	1.3 (± 0.11)	0.91 (± 0.14)	0.1 (± 0.08)	28.46 (± 37.87)	1.74 (± 1.4)	0.25 (± 0.14)	1.05 (± 0.57)
Low Costs, High Values - IM	1.52 (± 1.51)	1.79 (± 0.86)	1.09 (± 0.5)	0.11 (± 0.07)	3504.31 (± 6067.65)	2.24 (± 1.18)	0.35 (± 0.14)	1.17 (± 0.29)
Standard Markets - IM	1.17 (± 1.25)	1.31 (± 0.11)	0.74 (± 0.1)	0.1 (± 0.08)	1.22 (± 0.93)	1.66 (± 1.37)	0.25 (± 0.14)	1 (± 0.54)
Technology Creep - IM	1.18 (± 1.22)	1.3 (± 0.11)	0.88 (± 0.12)	0.1 (± 0.08)	5.02 (± 3.23)	1.73 (± 1.4)	0.25 (± 0.14)	1.02 (± 0.55)
No Acclimation - 2010 coastal context - IM	0.16 (± 0.17)	0.22 (± 0.11)	0.12 (± 0.05)	0.08 (± 0.05)	0.48 (± 0.3)	0.84 (± 0.77)	0.12 (± 0.08)	0.81 (± 0.51)
No Acclimation - Cumulative impacts - SQ	0.92 (± 1.33)	0.36 (± 0.2)	0.08 (± 0.05)	0.05 (± 0.04)	5.7 (± 9.59)	0.93 (± 0.6)	0.07 (± 0.08)	0.57 (± 0.28)

Scenario	Crabs	Prawns	Krill	Deposit feeders	Macroalgae	Seagrass	Worms	Jellies
No Climate change - 2010 context - SQ	0.32 (± 0.05)	7.23 (± 0.21)	1.18 (± 0.08)	2.94 (± 0.17)	7.39 (± 0.48)	2.68 (± 2.15)	2.28 (± 0.07)	0.93 (± 0.28)
2010 coastal context - Cap ecosystem take	0.1 (± 0.06)	6.32 (± 1.82)	1.53 (± 0.42)	2.42 (± 0.47)	9.06 (± 2.1)	3.56 (± 3.56)	1.82 (± 0.03)	1.48 (± 0.71)
2010 coastal context - Centralised mgmt.	0.1 (± 0.07)	5.2 (± 0.5)	1.37 (± 0.61)	2.58 (± 0.27)	10.32 (± 0.15)	5.01 (± 6.06)	1.96 (± 0.22)	1.07 (± 0.01)
2010 coastal context - FewMPA	0.05 (± 0.04)	0.54 (± 0.06)	1.42 (± 0.64)	2.37 (± 0.24)	10.33 (± 0.14)	5.03 (± 6.01)	1.75 (± 0.19)	1.11 (± 0.01)
2010 coastal context - Fragmented mgmt	0.1 (± 0.07)	5.07 (± 0.64)	1.38 (± 0.62)	2.57 (± 0.27)	10.32 (± 0.15)	5.01 (± 6.06)	1.96 (± 0.22)	1.07 (± 0.01)
2010 coastal context - ManyMPA	0.11 (± 0.07)	7.73 (± 1.14)	1.36 (± 0.61)	2.59 (± 0.26)	10.35 (± 0.15)	5.1 (± 6.2)	1.95 (± 0.22)	1.06 (± 0.01)
2010 coastal context - Seasons	0.11 (± 0.07)	7.34 (± 0.16)	1.36 (± 0.61)	2.59 (± 0.27)	10.32 (± 0.15)	5.06 (± 6.11)	1.95 (± 0.22)	1.06 (± 0.01)
2010 coastal context - SlowAssess	0.67 (± 1.03)	12.24 (± 6.79)	0.96 (± 0.5)	2.74 (± 0.13)	6.44 (± 3.62)	5 (± 6.06)	2.1 (± 0.23)	1.07 (± 0.02)
2010 coastal context - Integrated Mgmt (IM)	0.3 (± 0.23)	15.48 (± 7.38)	0.73 (± 0.51)	3.17 (± 0.53)	9.02 (± 0.48)	4.88 (± 5.66)	2.86 (± 0.79)	0.82 (± 0.43)
Cumulative impacts - 2010 Status Quo (SQ)	0.17 (± 0.12)	0.81 (± 0.18)	1.06 (± 0.57)	2.24 (± 0.18)	6.19 (± 0.09)	5.07 (± 6.09)	1.96 (± 0.01)	1.16 (± 0.01)
Cumulative impacts - Cap ecosystem take	0.18 (± 0.1)	1.04 (± 0.27)	1.14 (± 0.43)	2.09 (± 0.09)	5.44 (± 1.26)	3.61 (± 3.58)	1.83 (± 0.21)	1.58 (± 0.75)
Cumulative impacts - Centralised mgmt.	0.18 (± 0.12)	0.86 (± 0.14)	1.06 (± 0.56)	2.25 (± 0.18)	6.19 (± 0.09)	5.07 (± 6.1)	1.96 (± 0.01)	1.15 (± 0.01)
Cumulative impacts - FewMPA	0.1 (± 0.06)	0.09 (± 0.02)	1.09 (± 0.59)	2.07 (± 0.18)	6.2 (± 0.09)	5.09 (± 6.05)	1.74 (± 0)	1.19 (± 0.01)
Cumulative impacts - Fragmented mgmt	0.18 (± 0.12)	0.84 (± 0.11)	1.06 (± 0.57)	2.25 (± 0.18)	6.19 (± 0.09)	5.07 (± 6.1)	1.96 (± 0.01)	1.15 (± 0.01)
Cumulative impacts - ManyMPA	0.19 (± 0.13)	1.28 (± 0.22)	1.04 (± 0.56)	2.26 (± 0.19)	6.21 (± 0.09)	5.16 (± 6.24)	1.94 (± 0.01)	1.14 (± 0.01)
Cumulative impacts - Seasons	0.19 (± 0.13)	1.22 (± 0.17)	1.04 (± 0.56)	2.26 (± 0.19)	6.19 (± 0.09)	5.12 (± 6.15)	1.94 (± 0.01)	1.14 (± 0.01)
Cumulative impacts - SlowAssess	0.26 (± 0.25)	0.49 (± 0.28)	1.34 (± 0.51)	2.31 (± 0.25)	8.79 (± 2.36)	5.09 (± 6.07)	1.86 (± 0.17)	1.15 (± 0.01)

Scenario	Crabs	Prawns	Krill	Deposit feeders	Macroalgae	Seagrass	Worms	Jellies
Cumulative impacts - IM	0.27 (± 0.31)	0.62 (± 0.35)	0.97 (± 0.57)	2.67 (± 0.47)	5.57 (± 1.66)	2.37 (± 1.85)	2.55 (± 0.75)	0.88 (± 0.47)
Expanded LTL fishery - IM	0.1 (± 0.07)	5.47 (± 0.52)	1.37 (± 0.61)	2.59 (± 0.27)	10.34 (± 0.15)	5.06 (± 6.14)	1.97 (± 0.22)	1.07 (± 0.01)
New mesopelgic fishery - IM	0.1 (± 0.07)	5.77 (± 0.62)	1.37 (± 0.61)	2.59 (± 0.27)	10.34 (± 0.15)	5.06 (± 6.13)	1.97 (± 0.22)	1.07 (± 0.01)
Extreme climate events - IM	0.1 (± 0.07)	4.85 (± 0.4)	1.38 (± 0.61)	2.57 (± 0.26)	10.32 (± 0.15)	5.01 (± 6.06)	1.96 (± 0.22)	1.08 (± 0.01)
Blooms - IM	0.1 (± 0.07)	4.85 (± 0.34)	1.38 (± 0.62)	2.57 (± 0.26)	10.32 (± 0.15)	5.01 (± 6.07)	1.96 (± 0.22)	1.08 (± 0.01)
Primary production regime shift - IM	0.24 (± 0.27)	5.15 (± 1.03)	1.32 (± 0.63)	2.72 (± 0.52)	8.53 (± 3.25)	4.69 (± 6.31)	1.97 (± 0.21)	1.07 (± 0.02)
Fish kills - IM	0.1 (± 0.07)	4.84 (± 0.62)	1.38 (± 0.62)	2.57 (± 0.26)	10.32 (± 0.15)	5.01 (± 6.05)	1.96 (± 0.22)	1.08 (± 0.01)
Range extensions - IM	0.1 (± 0.07)	4.83 (± 0.3)	1.39 (± 0.63)	2.57 (± 0.26)	10.33 (± 0.15)	5.01 (± 6.08)	1.96 (± 0.22)	1.07 (± 0.01)
Gear switching allowed - IM	0.1 (± 0.07)	7.28 (± 0.27)	1.36 (± 0.61)	2.59 (± 0.27)	10.33 (± 0.15)	5.1 (± 6.18)	1.95 (± 0.22)	1.06 (± 0.01)
High compliance - IM	0.1 (± 0.07)	5.04 (± 0.96)	1.37 (± 0.61)	2.58 (± 0.27)	10.32 (± 0.15)	5.01 (± 6.05)	1.96 (± 0.22)	1.07 (± 0.02)
Low Compliance - IM	0.09 (± 0.06)	4.65 (± 0.41)	1.39 (± 0.63)	2.56 (± 0.26)	10.32 (± 0.15)	5 (± 6.05)	1.96 (± 0.22)	1.08 (± 0.01)
Flexible fisher behaviour - IM	0.1 (± 0.07)	5.25 (± 0.47)	1.37 (± 0.61)	2.58 (± 0.26)	10.32 (± 0.15)	5.02 (± 6.07)	1.96 (± 0.22)	1.07 (± 0.01)
Increased fishing pressure drivers - IM	0.1 (± 0.07)	4.82 (± 0.58)	1.38 (± 0.61)	2.57 (± 0.26)	10.32 (± 0.15)	5.01 (± 6.05)	1.96 (± 0.22)	1.08 (± 0.01)
High Cost, Low Values - IM	0.11 (± 0.07)	7.93 (± 0.74)	1.36 (± 0.61)	2.59 (± 0.27)	10.33 (± 0.15)	5.06 (± 6.11)	1.95 (± 0.22)	1.06 (± 0.01)
Low Costs, High Values - IM	0.11 (± 0.05)	7.81 (± 4.2)	1.68 (± 0.35)	2.28 (± 0.72)	10.51 (± 0.44)	4.3 (± 4.84)	1.68 (± 0.27)	1.88 (± 1.4)
Standard Markets - IM	0.1 (± 0.07)	4.82 (± 0.58)	1.38 (± 0.61)	2.57 (± 0.26)	10.32 (± 0.15)	5.01 (± 6.05)	1.96 (± 0.22)	1.08 (± 0.01)
Technology Creep - IM	0.1 (± 0.07)	6.08 (± 0.28)	1.36 (± 0.61)	2.6 (± 0.27)	10.32 (± 0.15)	5.05 (± 6.1)	1.95 (± 0.22)	1.06 (± 0.01)
No Acclimation - 2010 coastal context - IM	0.08 (± 0.07)	3.81 (± 1.06)	1.15 (± 0.74)	1.12 (± 0.15)	5.01 (± 0.49)	6.98 (± 8.27)	1.15 (± 0.59)	1.23 (± 0.38)
No Acclimation - Cumulative impacts - SQ	0.04 (± 0.03)	1.53 (± 1.2)	1.86 (± 1.09)	0.93 (± 0.28)	7.03 (± 0.56)	16.91 (± 24.58)	0.98 (± 0.9)	2.61 (± 2.68)

Scenario	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria	Sediment bacteria	Meiobenthos
No Climate change - 2010 context - SQ	0.29 (± 0.03)	1.23 (± 0.01)	0.85 (± 0.49)	0.8 (± 0.06)	5.16 (± 0.9)	2.89 (± 0.08)	0.69 (± 0.07)
2010 coastal context - Cap ecosystem take	1.06 (± 0.23)	1.53 (± 0.48)	0.59 (± 0.15)	0.76 (± 0.04)	2.03 (± 0.78)	5.82 (± 1.74)	2.22 (± 0.75)
2010 coastal context - Centralised mgmt.	1.24 (± 0.29)	1.71 (± 0.17)	0.6 (± 0.14)	0.77 (± 0.06)	2.59 (± 1.76)	6.53 (± 0.55)	2.33 (± 0.58)
2010 coastal context - FewMPA	1.27 (± 0.3)	1.71 (± 0.18)	0.6 (± 0.14)	0.78 (± 0.06)	2.62 (± 1.78)	6.76 (± 0.59)	2.39 (± 0.6)
2010 coastal context - Fragmented mgmt	1.25 (± 0.29)	1.73 (± 0.18)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.56 (± 0.53)	2.33 (± 0.59)
2010 coastal context - ManyMPA	1.23 (± 0.29)	1.68 (± 0.17)	0.59 (± 0.13)	0.76 (± 0.06)	2.58 (± 1.75)	6.42 (± 0.56)	2.3 (± 0.58)
2010 coastal context - Seasons	1.23 (± 0.29)	1.68 (± 0.17)	0.59 (± 0.14)	0.76 (± 0.06)	2.58 (± 1.75)	6.42 (± 0.56)	2.3 (± 0.57)
2010 coastal context - SlowAssess	0.63 (± 0.27)	1.58 (± 0.19)	0.57 (± 0.12)	0.78 (± 0.06)	3.16 (± 1.54)	4.9 (± 2.03)	1.91 (± 0.32)
2010 coastal context - Integrated Mgmt (IM)	1.27 (± 0.72)	1.34 (± 0.2)	0.52 (± 0.1)	0.82 (± 0.07)	6.66 (± 1.76)	1.66 (± 1.36)	0.66 (± 0.26)
Cumulative impacts - 2010 Status Quo (SQ)	0.63 (± 0.04)	1.55 (± 0.09)	0.6 (± 0.14)	0.81 (± 0.06)	3.76 (± 0.88)	3.54 (± 0.77)	1.73 (± 0.02)

Scenario	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria	Sediment bacteria	Meiobenthos
Cumulative impacts - Cap ecosystem take	0.56 (± 0.16)	1.35 (± 0.27)	0.6 (± 0.15)	0.79 (± 0.04)	3.17 (± 0.14)	2.99 (± 0.17)	1.61 (± 0.2)
Cumulative impacts - Centralised mgmt.	0.63 (± 0.04)	1.54 (± 0.09)	0.6 (± 0.14)	0.81 (± 0.06)	3.75 (± 0.88)	3.51 (± 0.77)	1.72 (± 0.02)
Cumulative impacts - FewMPA	0.65 (± 0.04)	1.54 (± 0.08)	0.6 (± 0.14)	0.81 (± 0.06)	3.79 (± 0.88)	3.63 (± 0.79)	1.77 (± 0.02)
Cumulative impacts - Fragmented mgmt	0.63 (± 0.04)	1.55 (± 0.09)	0.6 (± 0.14)	0.81 (± 0.06)	3.76 (± 0.87)	3.53 (± 0.77)	1.72 (± 0.03)
Cumulative impacts - ManyMPA	0.63 (± 0.04)	1.51 (± 0.08)	0.6 (± 0.14)	0.8 (± 0.06)	3.73 (± 0.87)	3.45 (± 0.74)	1.7 (± 0.02)
Cumulative impacts - Seasons	0.63 (± 0.04)	1.51 (± 0.08)	0.6 (± 0.14)	0.8 (± 0.06)	3.73 (± 0.87)	3.45 (± 0.74)	1.7 (± 0.02)
Cumulative impacts - SlowAssess	0.97 (± 0.47)	1.68 (± 0.26)	0.58 (± 0.12)	0.81 (± 0.06)	3.23 (± 1.54)	5.54 (± 2.21)	2.52 (± 1.19)
Cumulative impacts - IM	1.96 (± 2.92)	1.43 (± 0.33)	0.52 (± 0.1)	0.86 (± 0.08)	7.08 (± 2.8)	2.22 (± 2.23)	0.8 (± 0.25)
Expanded LTL fishery - IM	1.24 (± 0.29)	1.7 (± 0.16)	0.59 (± 0.13)	0.77 (± 0.06)	2.59 (± 1.76)	6.72 (± 0.57)	2.32 (± 0.58)
New mesopelgic fishery - IM	1.24 (± 0.29)	1.7 (± 0.16)	0.59 (± 0.13)	0.77 (± 0.06)	2.59 (± 1.76)	6.69 (± 0.58)	2.32 (± 0.57)
Extreme climate events - IM	1.24 (± 0.29)	1.72 (± 0.17)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.59 (± 0.6)	2.34 (± 0.58)
Blooms - IM	1.25 (± 0.29)	1.73 (± 0.18)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.59 (± 0.6)	2.34 (± 0.59)
Primary production regime shift - IM	1.11 (± 0.52)	1.71 (± 0.16)	0.57 (± 0.12)	0.78 (± 0.06)	2.61 (± 1.75)	6.77 (± 0.89)	2.48 (± 0.6)
Fish kills - IM	1.24 (± 0.29)	1.72 (± 0.16)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.58 (± 0.56)	2.34 (± 0.58)
Range extensions - IM	1.25 (± 0.29)	1.72 (± 0.18)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.75)	6.6 (± 0.57)	2.34 (± 0.6)
Gear switching allowed - IM	1.23 (± 0.29)	1.68 (± 0.17)	0.59 (± 0.14)	0.76 (± 0.06)	2.58 (± 1.75)	6.42 (± 0.56)	2.3 (± 0.58)
High compliance - IM	1.24 (± 0.29)	1.72 (± 0.15)	0.6 (± 0.13)	0.77 (± 0.07)	2.6 (± 1.77)	6.55 (± 0.5)	2.33 (± 0.57)
Low Compliance - IM	1.25 (± 0.29)	1.75 (± 0.18)	0.6 (± 0.14)	0.78 (± 0.06)	2.6 (± 1.76)	6.64 (± 0.57)	2.36 (± 0.6)
Flexible fisher behaviour - IM	1.24 (± 0.29)	1.71 (± 0.17)	0.6 (± 0.14)	0.77 (± 0.06)	2.59 (± 1.76)	6.52 (± 0.57)	2.32 (± 0.58)
Increased fishing pressure drivers - IM	1.25 (± 0.29)	1.72 (± 0.16)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.59 (± 0.58)	2.34 (± 0.58)
High Cost, Low Values - IM	1.23 (± 0.29)	1.68 (± 0.17)	0.59 (± 0.14)	0.76 (± 0.06)	2.58 (± 1.75)	6.42 (± 0.56)	2.3 (± 0.58)
Low Costs, High Values - IM	0.88 (± 0.46)	1.34 (± 0.8)	0.58 (± 0.16)	0.74 (± 0.01)	1.46 (± 0.2)	5.05 (± 3.01)	2.1 (± 0.93)
Standard Markets - IM	1.25 (± 0.29)	1.72 (± 0.16)	0.6 (± 0.14)	0.77 (± 0.06)	2.6 (± 1.76)	6.59 (± 0.58)	2.34 (± 0.58)
Technology Creep - IM	1.24 (± 0.29)	1.68 (± 0.17)	0.59 (± 0.14)	0.76 (± 0.06)	2.58 (± 1.75)	6.44 (± 0.57)	2.31 (± 0.57)
No Acclimation - 2010 coastal context - IM	0.38 (± 0.35)	1.52 (± 1.06)	0.54 (± 0.3)	0.87 (± 0.2)	7.86 (± 6.53)	20.11 (± 27.43)	1.02 (± 0.24)
No Acclimation - Cumulative impacts - SQ	1.44 (± 1.67)	1.73 (± 0.85)	0.63 (± 0.36)	0.83 (± 0.17)	4.06 (± 3.51)	90.09 (± 136.3)	3.48 (± 2.27)

Scenario	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	17.09 (± 3.09)	11.95 (± 1.38)
2010 coastal context - Cap ecosystem take	146 (± 252.02)	9.5 (± 15.17)
2010 coastal context - Centralised mgmt.	229.58 (± 396.78)	14.66 (± 24.12)
2010 coastal context - FewMPA	235.78 (± 407.49)	14.8 (± 24.34)
2010 coastal context - Fragmented mgmt	229.99 (± 397.48)	14.7 (± 24.17)
2010 coastal context - ManyMPA	224.07 (± 387.25)	14.36 (± 23.61)
2010 coastal context - Seasons	224.09 (± 387.29)	14.35 (± 23.6)
2010 coastal context - SlowAssess	679.9 (± 1164.94)	66.34 (± 105.07)
2010 coastal context - Integrated Mgmt (IM)	540.24 (± 748.8)	96.88 (± 108.54)
Cumulative impacts - 2010 Status Quo (SQ)	702.11 (± 1203.53)	68.97 (± 109.94)
Cumulative impacts - Cap ecosystem take	444.76 (± 757.81)	44.88 (± 68.3)
Cumulative impacts - Centralised mgmt.	697.16 (± 1195)	68.53 (± 109.22)
Cumulative impacts - FewMPA	715.99 (± 1227.23)	69.19 (± 110.22)
Cumulative impacts - Fragmented mgmt	698.43 (± 1197.06)	68.69 (± 109.41)
Cumulative impacts - ManyMPA	680.46 (± 1166.25)	67.11 (± 106.9)
Cumulative impacts - Seasons	680.53 (± 1166.37)	67.09 (± 106.86)
Cumulative impacts - SlowAssess	240.09 (± 414.66)	15.72 (± 25.21)
Cumulative impacts - IM	171.8 (± 280.2)	22.48 (± 25.17)
Expanded LTL fishery - IM	234.24 (± 404.83)	14.79 (± 24.33)
New mesopelgic fishery - IM	234.24 (± 404.84)	14.79 (± 24.33)
Extreme climate events - IM	230.18 (± 397.83)	14.7 (± 24.17)
Blooms - IM	229.28 (± 396.26)	14.66 (± 24.1)
Primary production regime shift - IM	230.7 (± 398.71)	14.74 (± 24.23)
Fish kills - IM	231.22 (± 399.61)	14.76 (± 24.28)
Range extensions - IM	229.28 (± 396.25)	14.66 (± 24.09)
Gear switching allowed - IM	223.98 (± 387.09)	14.35 (± 23.59)
High compliance - IM	232.68 (± 402.16)	14.84 (± 24.43)
Low Compliance - IM	231.46 (± 400.01)	14.8 (± 24.32)
Flexible fisher behaviour - IM	228.08 (± 394.19)	14.59 (± 23.99)
Increased fishing pressure drivers - IM	231.22 (± 399.61)	14.76 (± 24.28)
High Cost, Low Values - IM	223.88 (± 386.93)	14.34 (± 23.58)

Scenario	Labile detritus	Refractory detritus
Low Costs, High Values - IM	60.79 (± 104.42)	4.23 (± 6.08)
Standard Markets - IM	231.22 (± 399.61)	14.76 (± 24.28)
Technology Creep - IM	225.11 (± 389.06)	14.42 (± 23.72)
No Acclimation - 2010 coastal context - IM	2313.45 (± 4000.18)	307.04 (± 521.9)
No Acclimation - Cumulative impacts - SQ	3349.43 (± 5800.95)	265.13 (± 457.84)

Table A. 8: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SEAP for each strategy-scenario combination under RCP 4.5. Biomass is relative to 2010 model values.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.76 (± 0.24)	1.55 (± 0.75)	1.5 (± 1.32)	11.24 (± 4.75)	5.87 (± 8.46)	0.39 (± 0.21)	3.03 (± 2.64)	6.43 (± 2.29)
2010 coastal context - Cap ecosystem take	5.49 (± 6.72)	30.18 (± 51.41)	11.75 (± 17.64)	298.14 (± 502.77)	3.21 (± 2.63)	0.49 (± 0.47)	19.36 (± 33.39)	295.56 (± 505.01)
2010 coastal context - Centralised mgmt.	6.02 (± 6.45)	35.5 (± 60.66)	11.6 (± 17.58)	302.72 (± 506.95)	4.22 (± 3.91)	0.75 (± 0.57)	29.09 (± 49.84)	299.65 (± 509.6)
2010 coastal context - FewMPA	5.6 (± 5.9)	16.71 (± 27.91)	8.91 (± 13.2)	240.18 (± 398.64)	2.51 (± 2)	0.17 (± 0.15)	14.76 (± 25.42)	237.12 (± 401.3)
2010 coastal context - Fragmented mgmt	6.04 (± 6.44)	33.85 (± 58.16)	11.53 (± 17.39)	298.66 (± 500.2)	4.19 (± 3.71)	0.3 (± 0.26)	16.46 (± 28.04)	295.62 (± 502.83)
2010 coastal context - ManyMPA	6 (± 6.4)	0.81 (± 1.26)	6.45 (± 9.73)	314.27 (± 526.73)	1.83 (± 1.52)	0.94 (± 0.77)	61.75 (± 105.43)	311.15 (± 529.44)
2010 coastal context - Seasons	6.02 (± 6.45)	18.06 (± 30.94)	6.6 (± 9.99)	304.59 (± 510.22)	1.69 (± 1.45)	0.92 (± 0.75)	32.47 (± 54.74)	301.52 (± 512.88)
2010 coastal context - SlowAssess	4.52 (± 7.53)	38.82 (± 65.86)	11.04 (± 18.65)	300.58 (± 506.2)	2.28 (± 2.81)	0.73 (± 0.22)	23.43 (± 39.97)	295.98 (± 510.18)
2010 coastal context - Integrated Mgmt (IM)	4.83 (± 8.22)	12.06 (± 19.74)	4.39 (± 6.8)	289.05 (± 481.09)	2.83 (± 3.88)	2.78 (± 1.62)	26.24 (± 40.33)	318.78 (± 541.95)
Cumulative impacts - 2010 Status Quo (SQ)	0.73 (± 0.97)	39.41 (± 67.33)	1.97 (± 2.91)	127.57 (± 206.56)	0.78 (± 0.55)	0.82 (± 1.16)	52.39 (± 90.1)	37.56 (± 62.59)
Cumulative impacts - Cap ecosystem take	0.71 (± 0.99)	47.34 (± 80.51)	1.98 (± 2.88)	127.6 (± 209.15)	0.62 (± 0.23)	0.67 (± 1.01)	54.78 (± 94.55)	37.66 (± 63.28)
Cumulative impacts - Centralised mgmt.	0.74 (± 0.98)	55.67 (± 95.01)	1.95 (± 2.88)	129.85 (± 210.61)	0.83 (± 0.65)	0.84 (± 1.14)	73.49 (± 126.01)	38.24 (± 63.8)
Cumulative impacts - FewMPA	0.68 (± 0.9)	26.26 (± 43.66)	1.5 (± 2.15)	103.57 (± 165.13)	0.63 (± 0.3)	0.22 (± 0.33)	39.63 (± 67.69)	30.36 (± 50.15)
Cumulative impacts - Fragmented mgmt	0.74 (± 0.98)	53.05 (± 91.12)	1.94 (± 2.84)	128.13 (± 207.79)	0.82 (± 0.57)	0.38 (± 0.55)	52.95 (± 90.57)	37.73 (± 62.95)
Cumulative impacts - ManyMPA	0.73 (± 0.97)	1.26 (± 1.99)	1.08 (± 1.59)	134.76 (± 218.87)	0.33 (± 0.18)	1.11 (± 1.56)	104.51 (± 177.32)	39.7 (± 66.29)
Cumulative impacts - Seasons	0.73 (± 0.98)	28.31 (± 48.47)	1.11 (± 1.63)	130.65 (± 211.98)	0.34 (± 0.21)	1.07 (± 1.49)	75.07 (± 128.1)	38.48 (± 64.21)
Cumulative impacts - SlowAssess	2.22 (± 1.4)	60.61 (± 103.39)	2.7 (± 2.32)	130.62 (± 208.85)	4.35 (± 6.82)	0.55 (± 0.94)	66.52 (± 114.97)	40.77 (± 61.3)
Cumulative impacts - IM	1.33 (± 0.68)	18.63 (± 31.15)	1.03 (± 0.86)	54.47 (± 78.26)	3.29 (± 4.39)	2.86 (± 4.92)	78.94 (± 134.67)	17.47 (± 22.48)
Expanded LTL fishery - IM	6.04 (± 6.43)	38.04 (± 65.1)	11.3 (± 17.11)	302.44 (± 506.61)	4.51 (± 4.02)	0.42 (± 0.34)	32.44 (± 55.43)	299.39 (± 509.25)
New mesopelgic fishery - IM	6.04 (± 6.43)	37.93 (± 65.2)	11.31 (± 17.09)	302.38 (± 506.66)	4.52 (± 4)	0.06 (± 0.08)	28.26 (± 48.19)	299.37 (± 509.27)
Extreme climate events - IM	6.02 (± 6.43)	28.25 (± 48.36)	11.91 (± 18.09)	307.04 (± 514.45)	4.14 (± 3.54)	0.44 (± 0.55)	24.31 (± 41.67)	303.97 (± 517.11)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
Blooms - IM	6.01 (± 6.41)	26.91 (± 46.11)	11.83 (± 17.92)	300.34 (± 502.76)	4.26 (± 3.79)	0.8 (± 0.7)	25.66 (± 43.9)	297.28 (± 505.42)
Primary production regime shift - IM	6.14 (± 6.64)	41.09 (± 70.61)	11.4 (± 17.19)	299.58 (± 501.99)	3.98 (± 3.52)	0.43 (± 0.43)	49.18 (± 84.85)	296.61 (± 504.58)
Fish kills - IM	6.01 (± 6.43)	27.91 (± 47.78)	11.81 (± 17.92)	301.53 (± 504.63)	3.98 (± 3.54)	0.22 (± 0.2)	29.75 (± 51.26)	298.41 (± 507.33)
Range extensions - IM	6.03 (± 6.44)	26.82 (± 44.36)	11.88 (± 18.05)	296.63 (± 497)	4.18 (± 3.81)	0.42 (± 0.34)	16.98 (± 28.86)	293.68 (± 499.55)
Gear switching allowed - IM	5.97 (± 6.35)	44.75 (± 75.79)	6.63 (± 10.07)	312.26 (± 523.63)	2.11 (± 1.89)	0.89 (± 0.71)	48.31 (± 82.15)	309.22 (± 526.26)
High compliance - IM	6.02 (± 6.44)	33.08 (± 56.74)	11.48 (± 17.4)	300.86 (± 503.9)	4.32 (± 3.81)	0.72 (± 0.58)	44.53 (± 77.01)	297.81 (± 506.54)
Low Compliance - IM	6.09 (± 6.51)	26.14 (± 45)	12.16 (± 18.41)	306.02 (± 512.72)	6.36 (± 6.09)	0.66 (± 0.52)	19.47 (± 33.51)	302.96 (± 515.37)
Flexible fisher behaviour - IM	5.79 (± 6.18)	29.55 (± 50.41)	10.58 (± 16.05)	296.12 (± 495.36)	4.03 (± 3.55)	0.34 (± 0.55)	17.57 (± 29.67)	293.02 (± 498.05)
Increased fishing pressure drivers - IM	5.98 (± 6.38)	25.14 (± 42.98)	11.72 (± 17.77)	297.25 (± 497.34)	4 (± 3.55)	0.62 (± 0.48)	31.8 (± 54.82)	294.16 (± 500.02)
High Cost, Low Values - IM	6 (± 6.41)	3.57 (± 5.5)	6.47 (± 9.78)	311.36 (± 521.87)	2.11 (± 1.83)	0.95 (± 0.77)	14.17 (± 23.13)	308.27 (± 524.55)
Low Costs, High Values - IM	4.99 (± 7.16)	35.21 (± 59.85)	11.79 (± 17.5)	299.04 (± 508.21)	2.42 (± 2.62)	0.12 (± 0.1)	23.23 (± 40.22)	296.96 (± 510)
Standard Markets - IM	5.98 (± 6.38)	25.14 (± 42.98)	11.72 (± 17.77)	297.25 (± 497.34)	4 (± 3.55)	0.67 (± 0.56)	35.48 (± 61.19)	294.16 (± 500.02)
Technology Creep - IM	5.93 (± 6.35)	40.08 (± 68.55)	9.99 (± 15.33)	305.05 (± 510.92)	4.15 (± 3.62)	0.12 (± 0.17)	20.04 (± 33.45)	301.95 (± 513.61)
No Acclimation - 2010 coastal context - IM	2.91 (± 4.14)	25.99 (± 44.63)	6.64 (± 10.56)	172 (± 291.75)	2.02 (± 2.47)	0.44 (± 0.66)	9 (± 15.5)	170.67 (± 292.89)
No Acclimation - Cumulative impacts - SQ	3.07 (± 3.47)	55.61 (± 95.91)	17.58 (± 27.77)	431.25 (± 741.19)	1.52 (± 1.46)	0.17 (± 0.15)	5.99 (± 10.36)	430.1 (± 742.18)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.3 (± 0.27)	0.36 (± 0.08)	4.81 (± 6.1)	0.8 (± 0.7)	9.44 (± 4.72)	7.95 (± 7.11)	1.07 (± 1.24)	4.98 (± 7.79)
2010 coastal context - Cap ecosystem take	0.28 (± 0.09)	0.19 (± 0.11)	92.51 (± 154.36)	6.45 (± 11.14)	137.78 (± 228.83)	96.61 (± 167.16)	4.51 (± 7.8)	61.16 (± 105.89)
2010 coastal context - Centralised mgmt.	0.33 (± 0.06)	0.16 (± 0.11)	117.14 (± 196.39)	9.66 (± 16.64)	145.37 (± 239.5)	144.66 (± 249.89)	6.75 (± 11.66)	91.51 (± 158.36)
2010 coastal context - FewMPA	0.17 (± 0.15)	0.02 (± 0.02)	13.02 (± 21.67)	4.91 (± 8.48)	42.44 (± 70.01)	73.59 (± 127.28)	3.43 (± 5.94)	46.58 (± 80.64)
2010 coastal context - Fragmented mgmt	0.22 (± 0.1)	0.13 (± 0.16)	112.62 (± 188.35)	5.45 (± 9.37)	145.6 (± 240.71)	81.61 (± 140.77)	3.81 (± 6.57)	51.59 (± 89.24)
2010 coastal context - ManyMPA	0.27 (± 0.11)	1.17 (± 0.57)	163.55 (± 274.86)	20.48 (± 35.23)	176.34 (± 290.61)	306.55 (± 529.06)	14.31 (± 24.69)	193.83 (± 335.35)
2010 coastal context - Seasons	0.19 (± 0.04)	1.17 (± 0.53)	171.6 (± 289.4)	10.72 (± 18.33)	178.48 (± 293.9)	160.17 (± 275.57)	7.48 (± 12.86)	101.13 (± 174.79)
2010 coastal context - SlowAssess	0.19 (± 0.14)	0.64 (± 0.87)	909.99 (± 1561.48)	7.83 (± 13.31)	149.63 (± 236.35)	116.94 (± 200.07)	5.44 (± 9.35)	73.47 (± 127.23)
2010 coastal context - Integrated Mgmt (IM)	0.26 (± 0.15)	6.84 (± 8.15)	11.16 (± 2.25)	8.88 (± 13.34)	158.98 (± 247.6)	129.2 (± 203.21)	5.9 (± 9.59)	76.78 (± 132.84)
Cumulative impacts - 2010 Status Quo (SQ)	0.26 (± 0.22)	1.32 (± 0.77)	0.08 (± 0.14)	20.96 (± 36.04)	71.29 (± 115.88)	157.41 (± 270.09)	5.24 (± 9.01)	18.26 (± 31.6)
Cumulative impacts - Cap ecosystem take	0.26 (± 0.22)	9.75 (± 9.34)	0.08 (± 0.14)	21.91 (± 37.82)	74.91 (± 124.19)	164.47 (± 283.55)	5.48 (± 9.45)	19.13 (± 33.13)
Cumulative impacts - Centralised mgmt.	0.31 (± 0.25)	6.63 (± 6.8)	0.1 (± 0.18)	29.4 (± 50.4)	79.49 (± 129.61)	220.96 (± 377.59)	7.36 (± 12.59)	25.56 (± 44.24)
Cumulative impacts - FewMPA	0.19 (± 0.26)	1.14 (± 0.96)	0.01 (± 0.02)	15.85 (± 27.08)	23.25 (± 37.85)	119.27 (± 202.75)	3.97 (± 6.76)	13.75 (± 23.79)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Cumulative impacts - Fragmented mgmt	0.29 (± 0.25)	6.83 (± 8.07)	0.1 (± 0.17)	21.18 (± 36.23)	79.65 (± 130.23)	159.29 (± 271.35)	5.3 (± 9.05)	18.39 (± 31.82)
Cumulative impacts - ManyMPA	0.38 (± 0.36)	56.27 (± 47.93)	0.15 (± 0.25)	41.8 (± 70.93)	96.5 (± 157.21)	314.96 (± 530.75)	10.48 (± 17.71)	36.12 (± 62.45)
Cumulative impacts - Seasons	0.26 (± 0.21)	56.13 (± 47.52)	0.15 (± 0.26)	30.03 (± 51.24)	97.77 (± 158.91)	225.95 (± 383.67)	7.52 (± 12.8)	26.04 (± 45.04)
Cumulative impacts - SlowAssess	0.27 (± 0.19)	4.2 (± 6.75)	0.01 (± 0.01)	26.58 (± 46.01)	78.13 (± 131.03)	199.38 (± 345.05)	6.65 (± 11.5)	23.27 (± 40.25)
Cumulative impacts - IM	0.33 (± 0.3)	64.17 (± 77.84)	0 (± 0)	31.38 (± 54.04)	82.15 (± 137.95)	235.43 (± 405.2)	7.86 (± 13.5)	27.55 (± 47.2)
Expanded LTL fishery - IM	0.29 (± 0.13)	0.6 (± 0.42)	136.11 (± 228.55)	10.76 (± 18.52)	152.54 (± 251.34)	161.1 (± 278.09)	7.52 (± 12.98)	101.87 (± 176.26)
New mesopelgic fishery - IM	0.32 (± 0.18)	0.4 (± 0.23)	136.13 (± 228.54)	9.37 (± 16.11)	152.71 (± 251.18)	140.2 (± 241.91)	6.54 (± 11.29)	88.64 (± 153.34)
Extreme climate events - IM	0.37 (± 0.12)	0.05 (± 0.02)	107.87 (± 181.91)	8.07 (± 13.91)	127.44 (± 208.85)	120.91 (± 208.88)	5.64 (± 9.75)	76.49 (± 132.37)
Blooms - IM	0.41 (± 0.2)	0.04 (± 0.01)	119.89 (± 202.64)	8.52 (± 14.67)	129.91 (± 213.39)	127.52 (± 220.19)	5.95 (± 10.28)	80.65 (± 139.55)
Primary production regime shift - IM	0.39 (± 0.24)	0.49 (± 0.78)	99.37 (± 164.97)	16.37 (± 28.3)	158.54 (± 263.08)	245.42 (± 424.67)	11.45 (± 19.82)	155.36 (± 269.02)
Fish kills - IM	0.36 (± 0.06)	0.06 (± 0.03)	93.59 (± 156.48)	9.9 (± 17.1)	135.59 (± 223.41)	148.35 (± 256.63)	6.92 (± 11.98)	93.9 (± 162.58)
Range extensions - IM	0.37 (± 0.12)	0.24 (± 0.33)	122.33 (± 206.26)	5.62 (± 9.65)	132.43 (± 218.99)	84.1 (± 144.97)	3.92 (± 6.77)	53.15 (± 91.92)
Gear switching allowed - IM	0.23 (± 0.13)	1.12 (± 0.5)	164.31 (± 277.12)	16 (± 27.47)	167.02 (± 274.51)	239.35 (± 412.66)	11.17 (± 19.26)	151.27 (± 261.63)
High compliance - IM	0.37 (± 0.19)	0.4 (± 0.57)	75.32 (± 123.64)	14.84 (± 25.67)	148.53 (± 245.59)	222.48 (± 385.22)	10.39 (± 17.97)	140.88 (± 243.99)
Low Compliance - IM	0.31 (± 0.18)	0.24 (± 0.4)	95.7 (± 161.07)	6.48 (± 11.18)	126.95 (± 209.4)	97.03 (± 167.81)	4.53 (± 7.83)	61.41 (± 106.31)
Flexible fisher behaviour - IM	0.28 (± 0.04)	0.2 (± 0.08)	134.71 (± 226.84)	5.81 (± 9.93)	146.07 (± 240.34)	86.73 (± 149.28)	4.05 (± 6.96)	54.77 (± 94.68)
Increased fishing pressure drivers - IM	0.28 (± 0.07)	0.43 (± 0.66)	93.37 (± 156.67)	10.58 (± 18.29)	130.37 (± 214.13)	158.64 (± 274.44)	7.4 (± 12.81)	100.42 (± 173.86)
High Cost, Low Values - IM	0.12 (± 0.16)	1.22 (± 0.58)	183.35 (± 309.16)	4.62 (± 7.79)	180.85 (± 297.84)	68.78 (± 117.36)	3.21 (± 5.48)	43.26 (± 74.58)
Low Costs, High Values - IM	0.18 (± 0.12)	0.33 (± 0.25)	91.65 (± 152.05)	7.74 (± 13.41)	145.18 (± 243.54)	116.13 (± 201.13)	5.42 (± 9.39)	73.55 (± 127.39)
Standard Markets - IM	0.34 (± 0.07)	0.05 (± 0.03)	93.37 (± 156.67)	11.81 (± 20.41)	130.37 (± 214.13)	177.01 (± 306.26)	8.26 (± 14.29)	112.05 (± 194.01)
Technology Creep - IM	0.22 (± 0.08)	1.03 (± 0.39)	165.9 (± 279.6)	6.59 (± 11.22)	159.81 (± 262.52)	98.38 (± 168.81)	4.59 (± 7.88)	62.04 (± 107.14)
No Acclimation - 2010 coastal context - IM	0.26 (± 0.18)	0.03 (± 0.03)	10.78 (± 15.78)	2.99 (± 5.17)	131.99 (± 224.77)	44.88 (± 77.6)	2.09 (± 3.62)	28.4 (± 49.17)
No Acclimation - Cumulative impacts - SQ	0.42 (± 0.22)	0.01 (± 0.01)	2748.98 (± 4759.74)	1.99 (± 3.45)	111.64 (± 191.33)	29.92 (± 51.8)	1.4 (± 2.42)	18.94 (± 32.81)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	6.3 (± 7.06)	0.72 (± 0.58)	7.12 (± 6.95)	1.03 (± 1.04)	3.61 (± 5.81)	27.1 (± 11.01)	3.24 (± 0.31)	2.13 (± 0.03)
2010 coastal context - Cap ecosystem take	77.28 (± 133.73)	7.1 (± 12.25)	77.28 (± 133.73)	16.1 (± 27.86)	36.11 (± 59.92)	1471.06 (± 2530.86)	60.95 (± 104.18)	3.64 (± 3.25)
2010 coastal context - Centralised mgmt.	115.7 (± 199.94)	10.63 (± 18.3)	115.7 (± 199.93)	24.11 (± 41.65)	38.84 (± 62.28)	1488.65 (± 2556.33)	61.52 (± 105.16)	3.7 (± 3.29)
2010 coastal context - FewMPA	58.86 (± 101.83)	5.4 (± 9.33)	58.86 (± 101.83)	12.26 (± 21.21)	18.76 (± 29.98)	1175.99 (± 2014.8)	56.94 (± 97.3)	2.64 (± 2.31)
2010 coastal context - Fragmented mgmt	65.24 (± 112.65)	5.98 (± 10.32)	65.26 (± 112.64)	13.6 (± 23.47)	39.09 (± 63.02)	1468.75 (± 2522.26)	61.37 (± 104.94)	3.49 (± 2.99)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
2010 coastal context - ManyMPA	245.13 (± 423.35)	22.51 (± 38.77)	245.16 (± 423.32)	51.08 (± 88.19)	8.77 (± 14)	1546.08 (± 2655.54)	51.71 (± 88.39)	2.73 (± 2.26)
2010 coastal context - Seasons	128.03 (± 220.55)	11.77 (± 20.18)	128.06 (± 220.52)	26.69 (± 45.94)	14.18 (± 23.12)	1498.05 (± 2572.67)	47.9 (± 81.85)	2.8 (± 2.45)
2010 coastal context - SlowAssess	93.03 (± 160.51)	8.58 (± 14.67)	93.28 (± 160.29)	19.34 (± 33.47)	38.65 (± 66.09)	1485.82 (± 2545.77)	61.61 (± 106.29)	3.2 (± 3.56)
2010 coastal context - Integrated Mgmt (IM)	98.93 (± 166.14)	9.49 (± 14.89)	100.95 (± 164.47)	20.27 (± 34.9)	13.57 (± 23.39)	1586.22 (± 2716.4)	94.35 (± 162.16)	2.75 (± 2.64)
Cumulative impacts - 2010 Status Quo (SQ)	78.46 (± 135.26)	13.11 (± 22.51)	63.06 (± 107.95)	2.62 (± 4.51)	27.4 (± 46.82)	376.71 (± 624.86)	7.87 (± 13.27)	1.8 (± 1.45)
Cumulative impacts - Cap ecosystem take	82.11 (± 141.89)	13.7 (± 23.63)	65.84 (± 113.37)	2.74 (± 4.73)	29.89 (± 51.26)	377.31 (± 632.16)	8.1 (± 13.67)	1.79 (± 1.5)
Cumulative impacts - Centralised mgmt.	109.99 (± 189.22)	18.4 (± 31.48)	88.59 (± 150.87)	3.67 (± 6.3)	31.52 (± 53.82)	383.59 (± 636.98)	8.18 (± 13.8)	1.82 (± 1.52)
Cumulative impacts - FewMPA	59.27 (± 101.69)	9.93 (± 16.91)	47.86 (± 80.98)	1.98 (± 3.39)	15.22 (± 25.92)	304.78 (± 500.51)	7.57 (± 12.77)	1.3 (± 1.07)
Cumulative impacts - Fragmented mgmt	79.21 (± 136.05)	13.26 (± 22.62)	63.89 (± 108.39)	2.64 (± 4.53)	31.8 (± 54.38)	378.43 (± 628.51)	8.16 (± 13.77)	1.71 (± 1.37)
Cumulative impacts - ManyMPA	156.05 (± 266.59)	26.2 (± 44.27)	126.56 (± 211.82)	5.21 (± 8.88)	7.11 (± 12.1)	398.17 (± 661.89)	6.87 (± 11.6)	1.35 (± 1.03)
Cumulative impacts - Seasons	112.23 (± 192.47)	18.8 (± 31.99)	90.68 (± 153.22)	3.75 (± 6.41)	11.62 (± 19.88)	385.94 (± 641.11)	6.37 (± 10.74)	1.38 (± 1.13)
Cumulative impacts - SlowAssess	99.71 (± 172.51)	16.62 (± 28.75)	79.79 (± 137.99)	3.34 (± 5.74)	34.06 (± 54.78)	380.26 (± 636.58)	8.62 (± 13.59)	2.17 (± 1.24)
Cumulative impacts - IM	117.82 (± 202.51)	19.61 (± 33.78)	94.45 (± 161.84)	4.05 (± 6.65)	11.53 (± 19.74)	152.45 (± 244.03)	13.78 (± 20.22)	1.97 (± 0.73)
Expanded LTL fishery - IM	128.82 (± 222.52)	11.83 (± 20.38)	128.84 (± 222.51)	26.85 (± 46.35)	40.88 (± 65.5)	1487.46 (± 2554.47)	61.57 (± 105.23)	3.69 (± 3.28)
New mesopelgic fishery - IM	112.11 (± 193.57)	10.29 (± 17.73)	112.12 (± 193.56)	23.36 (± 40.32)	40.91 (± 65.47)	1487.39 (± 2554.52)	61.56 (± 105.23)	3.61 (± 3.33)
Extreme climate events - IM	96.69 (± 167.14)	8.87 (± 15.31)	96.71 (± 167.13)	20.15 (± 34.82)	35.24 (± 56.61)	1510.28 (± 2593.84)	59.4 (± 101.5)	3.61 (± 3.09)
Blooms - IM	101.96 (± 176.19)	9.35 (± 16.15)	101.98 (± 176.18)	21.25 (± 36.7)	35.28 (± 56.26)	1476.68 (± 2535.49)	59.39 (± 101.5)	3.65 (± 3.19)
Primary production regime shift - IM	196.31 (± 339.76)	18 (± 31.14)	196.32 (± 339.75)	40.9 (± 70.78)	45.15 (± 73.8)	1473.67 (± 2530.98)	65.07 (± 111.33)	3.56 (± 3.02)
Fish kills - IM	118.66 (± 205.32)	10.88 (± 18.82)	118.67 (± 205.32)	24.72 (± 42.77)	35.44 (± 57.27)	1482.34 (± 2545.07)	59.66 (± 101.95)	3.65 (± 3.17)
Range extensions - IM	67.23 (± 116.02)	6.17 (± 10.63)	67.25 (± 116)	14.01 (± 24.17)	36.48 (± 58.27)	1459.06 (± 2505.83)	59.92 (± 101.66)	4.02 (± 2.76)
Gear switching allowed - IM	191.36 (± 330.23)	17.57 (± 30.25)	191.4 (± 330.2)	39.88 (± 68.79)	16.43 (± 26.81)	1536.58 (± 2639.55)	61.94 (± 105.88)	3.23 (± 2.88)
High compliance - IM	178 (± 308.16)	16.34 (± 28.23)	177.98 (± 308.17)	37.09 (± 64.2)	40.3 (± 66.01)	1479.6 (± 2540.89)	61.73 (± 105.52)	3.56 (± 3.08)
Low Compliance - IM	77.61 (± 134.26)	7.12 (± 12.3)	77.62 (± 134.25)	16.17 (± 27.97)	44.44 (± 70.89)	1505.24 (± 2585.14)	61.51 (± 105.19)	3.56 (± 3.01)
Flexible fisher behaviour - IM	69.34 (± 119.46)	6.39 (± 10.92)	69.35 (± 119.45)	14.45 (± 24.88)	38.39 (± 61.38)	1455.44 (± 2498.61)	60.82 (± 103.94)	3.6 (± 3.1)
Increased fishing pressure drivers - IM	126.89 (± 219.57)	11.64 (± 20.12)	126.9 (± 219.57)	26.44 (± 45.74)	33.7 (± 54.24)	1461.11 (± 2508.47)	59.16 (± 101.09)	3.65 (± 3.15)
High Cost, Low Values - IM	54.9 (± 93.99)	5.05 (± 8.6)	54.95 (± 93.95)	11.45 (± 19.57)	9.37 (± 15.2)	1531.8 (± 2631.03)	49.37 (± 84.37)	2.73 (± 2.33)
Low Costs, High Values - IM	92.91 (± 160.9)	8.53 (± 14.74)	92.91 (± 160.91)	19.36 (± 33.52)	38.53 (± 65.61)	1481.01 (± 2553.25)	62.74 (± 107.28)	3.63 (± 3.34)
Standard Markets - IM	141.6 (± 245.02)	12.99 (± 22.45)	141.6 (± 245.02)	29.5 (± 51.04)	33.7 (± 54.24)	1461.11 (± 2508.47)	59.16 (± 101.09)	3.65 (± 3.15)
Technology Creep - IM	78.59 (± 135.15)	7.21 (± 12.38)	78.63 (± 135.11)	16.38 (± 28.15)	40.54 (± 65.13)	1500.21 (± 2576.31)	62.92 (± 107.56)	3.38 (± 2.99)
No Acclimation - 2010 coastal context - IM	35.89 (± 62.09)	3.29 (± 5.69)	35.9 (± 62.09)	7.48 (± 12.93)	33.57 (± 57.38)	851.02 (± 1466.46)	4.66 (± 7.9)	2.7 (± 2.8)
No Acclimation - Cumulative impacts - SQ	23.93 (± 41.44)	2.19 (± 3.8)	23.93 (± 41.44)	4.99 (± 8.63)	85.01 (± 131.83)	2147.91 (± 3713.14)	2.89 (± 4.95)	3.13 (± 3.58)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
No Climate change - 2010 context - SQ	6.24 (± 4.77)	0.54 (± 0.06)	1.81 (± 0.96)	0.41 (± 0.06)	6.2 (± 0.18)	1.62 (± 0.96)	0.99 (± 0.43)	0.51 (± 0.17)
2010 coastal context - Cap ecosystem take	223.32 (± 138.73)	2.92 (± 4.4)	52.28 (± 51.85)	2.29 (± 2.86)	2.64 (± 1.7)	11.07 (± 16.01)	11.48 (± 18.25)	0.03 (± 0.01)
2010 coastal context - Centralised mgmt.	252.79 (± 166.8)	2.94 (± 4.42)	42.66 (± 39.65)	2.49 (± 3.26)	3.05 (± 1.93)	11.1 (± 16.17)	11.44 (± 18.43)	0.03 (± 0)
2010 coastal context - FewMPA	163.63 (± 83.37)	2.85 (± 4.28)	13.34 (± 17.48)	0.02 (± 0.02)	2.75 (± 1.96)	10.86 (± 15.91)	7.18 (± 11.49)	0.03 (± 0)
2010 coastal context - Fragmented mgmt	240.69 (± 171.29)	2.94 (± 4.42)	55.42 (± 45.1)	2.17 (± 2.72)	3.19 (± 2.39)	11.1 (± 16.22)	11.46 (± 18.48)	0.03 (± 0)
2010 coastal context - ManyMPA	106.06 (± 174.92)	2.99 (± 4.48)	44.4 (± 75.17)	2.23 (± 2.81)	2.7 (± 1.85)	11.2 (± 16.28)	11.57 (± 18.64)	0.03 (± 0)
2010 coastal context - Seasons	58.61 (± 34.73)	3 (± 4.51)	3.18 (± 3.56)	2.57 (± 3.09)	2.42 (± 1.52)	11.28 (± 16.42)	11.54 (± 18.58)	0.03 (± 0)
2010 coastal context - SlowAssess	108.41 (± 172.8)	2.97 (± 4.38)	37.77 (± 63.71)	2.74 (± 2.97)	3.6 (± 2.04)	14.47 (± 14.42)	11.5 (± 18.47)	0.01 (± 0.01)
2010 coastal context - Integrated Mgmt (IM)	104.39 (± 174.98)	3.2 (± 4.69)	10.67 (± 17.81)	3.97 (± 5.99)	14.34 (± 13.87)	76.37 (± 104.45)	12.45 (± 19.8)	0.02 (± 0.03)
Cumulative impacts - 2010 Status Quo (SQ)	35.42 (± 50.56)	2.69 (± 3.9)	2.26 (± 1.88)	1.23 (± 1.65)	11.8 (± 15.99)	44.06 (± 71.2)	7.54 (± 12.09)	0 (± 0)
Cumulative impacts - Cap ecosystem take	40.25 (± 59.89)	2.69 (± 3.92)	1.92 (± 1.59)	1.26 (± 1.7)	10.47 (± 14.01)	44.77 (± 71.62)	7.66 (± 12.11)	0 (± 0)
Cumulative impacts - Centralised mgmt.	44.7 (± 66.54)	2.71 (± 3.94)	1.6 (± 1.33)	1.38 (± 1.93)	11.86 (± 15.65)	44.79 (± 72.41)	7.63 (± 12.24)	0 (± 0)
Cumulative impacts - FewMPA	30.53 (± 45.06)	2.63 (± 3.81)	0.6 (± 0.69)	0.01 (± 0.01)	10.86 (± 14.7)	43.91 (± 71.13)	4.79 (± 7.63)	0 (± 0)
Cumulative impacts - Fragmented mgmt	42.79 (± 64.34)	2.71 (± 3.94)	2.41 (± 2.51)	1.2 (± 1.62)	13.44 (± 18.92)	44.83 (± 72.56)	7.64 (± 12.27)	0 (± 0)
Cumulative impacts - ManyMPA	3.26 (± 3.41)	2.75 (± 4)	1.18 (± 1.94)	1.23 (± 1.67)	10.98 (± 15)	45.15 (± 72.93)	7.72 (± 12.37)	0 (± 0)
Cumulative impacts - Seasons	11.09 (± 16.65)	2.77 (± 4.02)	0.07 (± 0.05)	1.4 (± 1.84)	9.5 (± 12.6)	45.49 (± 73.5)	7.7 (± 12.34)	0 (± 0)
Cumulative impacts - SlowAssess	153.4 (± 107.21)	2.68 (± 3.95)	3.05 (± 2.64)	1.63 (± 1.72)	12.42 (± 19.57)	45.08 (± 72.37)	7.67 (± 12.26)	0.03 (± 0.03)
Cumulative impacts - IM	22.44 (± 15.11)	2.43 (± 3.45)	1.81 (± 1.69)	2.15 (± 3.61)	66.71 (± 110.86)	286.77 (± 489.36)	8.15 (± 13.28)	0.15 (± 0.21)
Expanded LTL fishery - IM	247.01 (± 157.66)	2.97 (± 4.45)	30.01 (± 26.66)	2.7 (± 3.45)	2.26 (± 1.46)	11.16 (± 16.28)	11.65 (± 18.76)	0.03 (± 0)
New mesopelgic fishery - IM	240.98 (± 168.1)	2.97 (± 4.45)	33.38 (± 27.45)	2.69 (± 3.45)	2.28 (± 1.48)	11.18 (± 16.27)	11.65 (± 18.76)	0.03 (± 0)
Extreme climate events - IM	243.99 (± 179.48)	2.92 (± 4.38)	71.31 (± 73.41)	2.37 (± 2.93)	2.72 (± 2.13)	10.9 (± 15.86)	11.3 (± 18.19)	0.03 (± 0)
Blooms - IM	233.95 (± 180.17)	2.92 (± 4.39)	75.21 (± 72.3)	2.25 (± 2.83)	2.59 (± 2.28)	10.91 (± 15.89)	11.32 (± 18.23)	0.03 (± 0)
Primary production regime shift - IM	274.25 (± 194.99)	3.01 (± 4.53)	31.79 (± 32.06)	4.87 (± 7.36)	2.38 (± 1.92)	20.81 (± 32.99)	12.06 (± 19.52)	0.03 (± 0.01)
Fish kills - IM	240.12 (± 175.35)	2.92 (± 4.39)	63.58 (± 63.05)	2.28 (± 2.98)	2.99 (± 2.14)	10.99 (± 16.01)	11.35 (± 18.29)	0.03 (± 0)
Range extensions - IM	251.66 (± 111.54)	3.03 (± 4.31)	84.26 (± 70.49)	2.59 (± 2.81)	3.19 (± 2.09)	11 (± 15.96)	11.3 (± 18.31)	0.03 (± 0.01)
Gear switching allowed - IM	258.23 (± 150.87)	3.01 (± 4.52)	8.03 (± 7.66)	2.36 (± 2.95)	2.4 (± 1.58)	11.36 (± 16.54)	11.55 (± 18.6)	0.03 (± 0)
High compliance - IM	252.69 (± 166.02)	2.94 (± 4.42)	41.08 (± 33.63)	2.65 (± 3.4)	3.08 (± 2.04)	11.12 (± 16.25)	11.49 (± 18.52)	0.03 (± 0)
Low Compliance - IM	178.89 (± 119.07)	2.91 (± 4.37)	79.01 (± 67.81)	2.12 (± 2.77)	2.42 (± 1.67)	10.87 (± 15.92)	11.34 (± 18.28)	0.03 (± 0)
Flexible fisher behaviour - IM	246.52 (± 168.72)	2.94 (± 4.41)	40.44 (± 41.48)	2.32 (± 2.94)	2.89 (± 2.25)	11.14 (± 16.23)	11.32 (± 18.23)	0.03 (± 0)
Increased fishing pressure drivers - IM	233.08 (± 172.74)	2.92 (± 4.38)	64.07 (± 67.64)	2.23 (± 2.77)	2.97 (± 2.06)	10.93 (± 15.9)	11.31 (± 18.2)	0.03 (± 0)
High Cost, Low Values - IM	19.32 (± 4.06)	3.01 (± 4.52)	2.86 (± 4.9)	2.22 (± 2.93)	2.35 (± 1.63)	11.29 (± 16.41)	11.59 (± 18.66)	0.03 (± 0.01)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
Low Costs, High Values - IM	213.56 (± 128.28)	2.92 (± 4.42)	40.48 (± 36.89)	2.34 (± 2.95)	2.3 (± 1.35)	11.21 (± 16.12)	11.66 (± 18.3)	0.04 (± 0.03)
Standard Markets - IM	233.08 (± 172.74)	2.92 (± 4.38)	64.07 (± 67.64)	2.23 (± 2.77)	2.97 (± 2.06)	10.93 (± 15.9)	11.31 (± 18.2)	0.03 (± 0)
Technology Creep - IM	246.86 (± 162.33)	2.98 (± 4.47)	9.38 (± 7.76)	2.15 (± 2.76)	3.25 (± 2.29)	11.35 (± 16.52)	11.67 (± 18.8)	0.03 (± 0)
No Acclimation - 2010 coastal context - IM	36.74 (± 23.48)	0.38 (± 0.32)	22.72 (± 20.67)	0.55 (± 0.62)	3.97 (± 2.72)	5.18 (± 7.36)	1.35 (± 2.11)	0.01 (± 0)
No Acclimation - Cumulative impacts - SQ	244.32 (± 173.52)	0.4 (± 0.35)	75.2 (± 74.3)	1.18 (± 1.86)	1.23 (± 1.12)	0.92 (± 1.02)	1.25 (± 1.93)	0.01 (± 0.01)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
No Climate change - 2010 context - SQ	0.52 (± 0.39)	1.34 (± 0.04)	1.1 (± 0.13)	0.15 (± 0.07)	1.35 (± 0.21)	0.88 (± 0.03)	0.46 (± 0.08)	2.01 (± 0.11)
2010 coastal context - Cap ecosystem take	4.6 (± 5.17)	49.89 (± 83.56)	10.13 (± 15.96)	2.79 (± 4.68)	18.95 (± 31.61)	1.41 (± 1.28)	0.92 (± 1.11)	21.32 (± 34.72)
2010 coastal context - Centralised mgmt.	4.17 (± 4.82)	49.44 (± 83.44)	10.38 (± 16.75)	2.83 (± 4.76)	0.62 (± 0.56)	1.42 (± 1.28)	0.87 (± 1.15)	21.58 (± 35.34)
2010 coastal context - FewMPA	4.28 (± 5.28)	50.45 (± 85.14)	4.75 (± 7.64)	2.14 (± 3.6)	49.17 (± 56.4)	0.92 (± 0.82)	0.88 (± 1.15)	16.35 (± 26.79)
2010 coastal context - Fragmented mgmt	4.07 (± 4.73)	49.57 (± 83.65)	10.47 (± 16.97)	2.84 (± 4.77)	0.4 (± 0.36)	1.4 (± 1.25)	0.87 (± 1.15)	21.64 (± 35.48)
2010 coastal context - ManyMPA	4.55 (± 5.91)	49.43 (± 83.43)	11.89 (± 19.18)	2.95 (± 4.96)	3.29 (± 3.01)	1.46 (± 1.31)	0.88 (± 1.15)	22.51 (± 36.87)
2010 coastal context - Seasons	3.84 (± 4.45)	49.8 (± 84.06)	11.87 (± 19.13)	2.92 (± 4.9)	3.27 (± 3.01)	1.46 (± 1.31)	0.87 (± 1.15)	22.26 (± 36.44)
2010 coastal context - SlowAssess	4.06 (± 4.95)	49.51 (± 83.66)	10.89 (± 16.07)	2.83 (± 4.74)	514.47 (± 889.77)	1.87 (± 1.86)	0.95 (± 1.09)	22.57 (± 34.4)
2010 coastal context - Integrated Mgmt (IM)	4.53 (± 5.23)	48.23 (± 81.4)	12.95 (± 18.74)	3.48 (± 5.86)	533.5 (± 689.67)	1.2 (± 0.98)	2.77 (± 3.86)	27.61 (± 42.7)
Cumulative impacts - 2010 Status Quo (SQ)	10.75 (± 16.48)	45.39 (± 76.49)	11.16 (± 17.79)	1.08 (± 1.76)	72.26 (± 125.11)	1.23 (± 0.83)	2.66 (± 4.06)	32.27 (± 52.77)
Cumulative impacts - Cap ecosystem take	11.21 (± 16.76)	45.58 (± 76.2)	11.8 (± 18.41)	1.1 (± 1.78)	92.94 (± 156.04)	1.53 (± 0.78)	2.74 (± 3.98)	32.87 (± 53.53)
Cumulative impacts - Centralised mgmt.	10.24 (± 15.38)	45.16 (± 76.1)	12.08 (± 19.32)	1.11 (± 1.82)	3.02 (± 4.92)	1.25 (± 0.83)	2.66 (± 4.06)	33.28 (± 54.48)
Cumulative impacts - FewMPA	10.81 (± 16.68)	46.08 (± 77.65)	5.53 (± 8.81)	0.84 (± 1.38)	7.86 (± 7.67)	0.81 (± 0.53)	2.67 (± 4.06)	25.22 (± 41.3)
Cumulative impacts - Fragmented mgmt	10.05 (± 15.17)	45.28 (± 76.29)	12.19 (± 19.58)	1.11 (± 1.82)	31.76 (± 54.99)	1.23 (± 0.8)	2.66 (± 4.06)	33.37 (± 54.7)
Cumulative impacts - ManyMPA	11.75 (± 18.46)	45.15 (± 76.09)	13.84 (± 22.12)	1.16 (± 1.89)	17.55 (± 29.84)	1.29 (± 0.84)	2.66 (± 4.06)	34.72 (± 56.83)
Cumulative impacts - Seasons	9.45 (± 14.24)	45.49 (± 76.67)	13.82 (± 22.07)	1.14 (± 1.87)	17.26 (± 29.34)	1.29 (± 0.84)	2.66 (± 4.06)	34.33 (± 56.18)
Cumulative impacts - SlowAssess	10.29 (± 15.62)	45.32 (± 76.22)	11.67 (± 19.4)	1.11 (± 1.81)	2.7 (± 4.57)	1.45 (± 1.37)	2.59 (± 4.12)	32.64 (± 54.8)
Cumulative impacts - IM	4.18 (± 6.81)	13.65 (± 21.55)	13.75 (± 22.75)	1.37 (± 2.24)	7.32 (± 12.67)	0.89 (± 0.77)	2.91 (± 4.44)	40.22 (± 67.78)
Expanded LTL fishery - IM	4.54 (± 5.16)	50.01 (± 84.4)	10.88 (± 17.57)	2.88 (± 4.84)	0.88 (± 0.81)	1.44 (± 1.3)	0.87 (± 1.15)	21.96 (± 35.97)
New mesopelgic fishery - IM	4.58 (± 5.15)	50.01 (± 84.4)	10.89 (± 17.56)	2.88 (± 4.84)	1.88 (± 2.42)	1.45 (± 1.33)	0.87 (± 1.15)	21.97 (± 35.96)
Extreme climate events - IM	3.77 (± 4.63)	49.79 (± 84.03)	9.42 (± 15.13)	2.73 (± 4.59)	0.34 (± 0.46)	1.4 (± 1.27)	0.87 (± 1.15)	20.84 (± 34.08)
Blooms - IM	3.75 (± 4.28)	49.77 (± 84.02)	9.56 (± 15.38)	2.74 (± 4.6)	0.24 (± 0.26)	1.39 (± 1.25)	0.87 (± 1.15)	20.9 (± 34.2)
Primary production regime shift - IM	3.33 (± 3.8)	50.44 (± 85.16)	12.04 (± 19.68)	3.25 (± 5.49)	1.33 (± 1.69)	1.47 (± 1.2)	0.87 (± 1.15)	24.76 (± 40.88)
Fish kills - IM	3.76 (± 4.33)	49.5 (± 83.54)	9.87 (± 15.93)	2.77 (± 4.66)	0.36 (± 0.38)	1.4 (± 1.27)	0.87 (± 1.15)	21.17 (± 34.66)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
Range extensions - IM	3.67 (± 4.5)	49.64 (± 83.91)	9.71 (± 15.71)	2.77 (± 4.65)	0.49 (± 0.6)	1.42 (± 1.29)	0.88 (± 1.15)	21.12 (± 34.56)
Gear switching allowed - IM	3.23 (± 3.51)	49.48 (± 83.51)	11.76 (± 18.96)	2.89 (± 4.86)	3.24 (± 2.98)	1.46 (± 1.31)	0.87 (± 1.15)	22.07 (± 36.15)
High compliance - IM	4.12 (± 4.7)	49.42 (± 83.4)	10.59 (± 17.19)	2.85 (± 4.79)	0.64 (± 0.59)	1.41 (± 1.29)	0.87 (± 1.15)	21.72 (± 35.6)
Low Compliance - IM	3.78 (± 4.43)	49.71 (± 83.89)	9.39 (± 15.19)	2.71 (± 4.56)	0.05 (± 0.07)	1.34 (± 1.18)	0.87 (± 1.15)	20.68 (± 33.92)
Flexible fisher behaviour - IM	2.98 (± 3.46)	49.36 (± 83.31)	10.31 (± 16.61)	2.82 (± 4.75)	0.62 (± 0.61)	1.42 (± 1.28)	0.87 (± 1.15)	21.55 (± 35.29)
Increased fishing pressure drivers - IM	4.28 (± 5.21)	49.69 (± 83.87)	9.58 (± 15.43)	2.74 (± 4.61)	0.37 (± 0.49)	1.4 (± 1.28)	0.87 (± 1.15)	20.92 (± 34.23)
High Cost, Low Values - IM	4.25 (± 5.16)	49.62 (± 83.75)	11.91 (± 19.2)	2.91 (± 4.9)	3.29 (± 3.01)	1.46 (± 1.31)	0.88 (± 1.15)	22.22 (± 36.39)
Low Costs, High Values - IM	4.91 (± 5.12)	50.08 (± 83.26)	10.68 (± 16.51)	2.83 (± 4.75)	0.57 (± 0.52)	1.97 (± 1.26)	0.97 (± 1.07)	21.72 (± 35.2)
Standard Markets - IM	4.28 (± 5.21)	49.69 (± 83.87)	9.58 (± 15.43)	2.74 (± 4.61)	0.37 (± 0.49)	1.4 (± 1.28)	0.87 (± 1.15)	20.92 (± 34.23)
Technology Creep - IM	4.31 (± 5.15)	49.36 (± 83.3)	11.43 (± 18.42)	2.83 (± 4.76)	2.58 (± 2.69)	0.8 (± 0.23)	0.87 (± 1.15)	21.59 (± 35.36)
No Acclimation - 2010 coastal context - IM	0.53 (± 0.58)	5.89 (± 9.78)	1.16 (± 1.78)	1.87 (± 3.11)	0.18 (± 0.21)	0.71 (± 0.71)	3.5 (± 5.87)	14.4 (± 23.06)
No Acclimation - Cumulative impacts - SQ	1.79 (± 1.45)	20.04 (± 34.26)	0.9 (± 1.42)	1.47 (± 2.46)	0.09 (± 0.14)	0.78 (± 0.58)	1.09 (± 1.77)	11.22 (± 18.23)

Scenario	Crabs	Prawns	Krill	Deposit feeders	Macroalgae	Seagrass	Worms	Jellies
No Climate change - 2010 context - SQ	0.32 (± 0.05)	7.23 (± 0.21)	1.18 (± 0.08)	2.94 (± 0.17)	7.39 (± 0.48)	2.68 (± 2.15)	2.28 (± 0.07)	0.93 (± 0.28)
2010 coastal context - Cap ecosystem take	1.54 (± 2.33)	15.49 (± 15.41)	22.07 (± 35.42)	46.03 (± 75.95)	73.07 (± 110.98)	34.84 (± 52.61)	18.45 (± 29.23)	20.01 (± 31.74)
2010 coastal context - Centralised mgmt.	1.56 (± 2.38)	14.77 (± 17.16)	21.83 (± 35.39)	46.39 (± 76.16)	74.33 (± 109.85)	36.32 (± 51.57)	18.59 (± 29.09)	19.52 (± 31.92)
2010 coastal context - FewMPA	0.84 (± 1.28)	11.12 (± 18.37)	22.59 (± 36.62)	42.63 (± 69.97)	74.4 (± 109.97)	37.33 (± 53.3)	16.57 (± 25.94)	20.23 (± 33.09)
2010 coastal context - Fragmented mgmt	1.57 (± 2.41)	14.36 (± 16.86)	21.81 (± 35.34)	46.41 (± 76.21)	74.33 (± 109.86)	36.34 (± 51.6)	18.58 (± 29.08)	19.51 (± 31.9)
2010 coastal context - ManyMPA	1.69 (± 2.57)	24.64 (± 30.56)	21.55 (± 34.93)	46.55 (± 76.41)	74.52 (± 110.15)	36.49 (± 51.64)	18.49 (± 28.94)	19.38 (± 31.7)
2010 coastal context - Seasons	1.64 (± 2.49)	20.79 (± 23.66)	21.57 (± 34.98)	46.56 (± 76.42)	74.32 (± 109.84)	36.69 (± 52.1)	18.48 (± 28.93)	19.38 (± 31.7)
2010 coastal context - SlowAssess	2.79 (± 2.37)	22.43 (± 12.84)	21.44 (± 35.77)	46.48 (± 75.9)	70.22 (± 113.44)	36.29 (± 51.57)	18.7 (± 29.02)	19.55 (± 31.98)
2010 coastal context - Integrated Mgmt (IM)	3.9 (± 5.69)	25.98 (± 11.47)	18.43 (± 31.01)	48.2 (± 77.84)	69.99 (± 107.94)	36.7 (± 52.46)	30.66 (± 49.09)	20.19 (± 33.81)
Cumulative impacts - 2010 Status Quo (SQ)	3.66 (± 5.87)	14.97 (± 24.52)	22.43 (± 37.28)	34.38 (± 55.58)	44.6 (± 65.91)	37.14 (± 52.88)	19.68 (± 31.12)	21.08 (± 34.49)
Cumulative impacts - Cap ecosystem take	3.76 (± 6.03)	15.98 (± 25.71)	22.41 (± 37.06)	34.38 (± 55.97)	43.84 (± 66.58)	35.68 (± 53.97)	19.56 (± 31.23)	21.44 (± 34)
Cumulative impacts - Centralised mgmt.	3.81 (± 6.13)	16.35 (± 26.83)	22.24 (± 36.96)	34.68 (± 56.09)	44.59 (± 65.91)	37.17 (± 52.92)	19.67 (± 31.11)	20.91 (± 34.2)
Cumulative impacts - FewMPA	2.05 (± 3.3)	1.63 (± 2.67)	23.02 (± 38.25)	31.87 (± 51.53)	44.63 (± 65.98)	38.2 (± 54.69)	17.54 (± 27.73)	21.67 (± 35.45)
Cumulative impacts - Fragmented mgmt	3.85 (± 6.21)	16.63 (± 27.38)	22.22 (± 36.91)	34.7 (± 56.13)	44.6 (± 65.91)	37.19 (± 52.95)	19.67 (± 31.09)	20.9 (± 34.17)
Cumulative impacts - ManyMPA	4.12 (± 6.64)	25.62 (± 42.21)	21.96 (± 36.48)	34.8 (± 56.27)	44.71 (± 66.09)	37.35 (± 52.99)	19.57 (± 30.94)	20.76 (± 33.97)
Cumulative impacts - Seasons	4 (± 6.43)	21.65 (± 35.32)	21.98 (± 36.53)	34.81 (± 56.28)	44.59 (± 65.9)	37.55 (± 53.46)	19.56 (± 30.93)	20.76 (± 33.96)
Cumulative impacts - SlowAssess	4.03 (± 6.06)	15.61 (± 26.48)	22.54 (± 36.75)	34.69 (± 55.95)	47.31 (± 63.56)	37.18 (± 52.86)	19.61 (± 31.19)	20.95 (± 34.26)

Scenario	Crabs	Prawns	Krill	Deposit feeders	Macroalgae	Seagrass	Worms	Jellies
Cumulative impacts - IM	8.93 (± 15.17)	19.68 (± 33.37)	19.3 (± 31.93)	36 (± 57.34)	32.43 (± 44.97)	31.6 (± 49.98)	32.26 (± 52.65)	21.64 (± 36.22)
Expanded LTL fishery - IM	1.62 (± 2.47)	15.11 (± 17.36)	21.76 (± 35.28)	46.52 (± 76.38)	74.44 (± 110.02)	36.44 (± 51.65)	18.7 (± 29.26)	19.56 (± 31.99)
New mesopelgic fishery - IM	1.62 (± 2.47)	15.4 (± 17.11)	21.76 (± 35.28)	46.52 (± 76.38)	74.44 (± 110.02)	36.44 (± 51.65)	18.7 (± 29.26)	19.55 (± 31.99)
Extreme climate events - IM	1.51 (± 2.3)	10.25 (± 9.73)	22.04 (± 35.75)	45.98 (± 75.47)	74.34 (± 109.87)	36.3 (± 51.53)	18.61 (± 29.12)	19.71 (± 32.25)
Blooms - IM	1.51 (± 2.3)	11.7 (± 12.29)	22.02 (± 35.71)	45.99 (± 75.48)	74.34 (± 109.87)	36.31 (± 51.55)	18.6 (± 29.11)	19.68 (± 32.2)
Primary production regime shift - IM	7.83 (± 13.25)	15.18 (± 18.48)	19.26 (± 30.94)	52.97 (± 87.57)	38.77 (± 48.28)	21.44 (± 26.08)	18.94 (± 29.71)	19.44 (± 31.79)
Fish kills - IM	1.52 (± 2.31)	15.45 (± 19)	21.95 (± 35.59)	46.08 (± 75.64)	74.33 (± 109.86)	36.29 (± 51.52)	18.6 (± 29.1)	19.61 (± 32.08)
Range extensions - IM	1.53 (± 2.33)	10.45 (± 10.13)	21.98 (± 35.62)	46.1 (± 75.67)	74.34 (± 109.87)	36.07 (± 51.13)	18.61 (± 29.12)	19.63 (± 32.13)
Gear switching allowed - IM	1.66 (± 2.53)	20.45 (± 23.21)	21.58 (± 34.99)	46.57 (± 76.44)	74.36 (± 109.9)	36.73 (± 52.06)	18.48 (± 28.93)	19.34 (± 31.64)
High compliance - IM	1.58 (± 2.42)	15.06 (± 18.24)	21.79 (± 35.31)	46.44 (± 76.26)	74.32 (± 109.85)	36.33 (± 51.59)	18.58 (± 29.07)	19.5 (± 31.88)
Low Compliance - IM	1.51 (± 2.32)	12.45 (± 13.99)	22.06 (± 35.75)	45.95 (± 75.42)	74.31 (± 109.83)	36.31 (± 51.56)	18.6 (± 29.11)	19.73 (± 32.26)
Flexible fisher behaviour - IM	1.55 (± 2.36)	15.44 (± 18.21)	21.83 (± 35.4)	46.35 (± 76.09)	74.33 (± 109.86)	36.35 (± 51.6)	18.59 (± 29.09)	19.53 (± 31.94)
Increased fishing pressure drivers - IM	1.5 (± 2.28)	11.96 (± 12.84)	22.01 (± 35.7)	45.99 (± 75.48)	74.33 (± 109.86)	36.29 (± 51.53)	18.6 (± 29.11)	19.67 (± 32.19)
High Cost, Low Values - IM	1.68 (± 2.57)	21.64 (± 24.4)	21.56 (± 34.95)	46.57 (± 76.44)	74.4 (± 109.97)	36.71 (± 52.13)	18.49 (± 28.94)	19.38 (± 31.71)
Low Costs, High Values - IM	1.59 (± 2.39)	19.01 (± 18.21)	22.12 (± 35.13)	46.08 (± 76.42)	74.52 (± 109.69)	35.59 (± 52.05)	18.31 (± 29.35)	20.34 (± 31.29)
Standard Markets - IM	1.5 (± 2.28)	11.96 (± 12.84)	22.01 (± 35.7)	45.99 (± 75.48)	74.33 (± 109.86)	36.29 (± 51.53)	18.6 (± 29.11)	19.67 (± 32.19)
Technology Creep - IM	1.65 (± 2.52)	17.1 (± 19.47)	21.62 (± 35.06)	46.61 (± 76.5)	74.33 (± 109.86)	36.58 (± 51.94)	18.56 (± 29.05)	19.43 (± 31.8)
No Acclimation - 2010 coastal context - IM	1.05 (± 1.52)	9.71 (± 10.15)	15.15 (± 24.05)	20.8 (± 34.24)	34.47 (± 50.27)	50.17 (± 70.98)	8.69 (± 12.98)	18.39 (± 29.52)
No Acclimation - Cumulative impacts - SQ	0.42 (± 0.6)	7.22 (± 10.84)	18.18 (± 27.59)	19.9 (± 33.15)	49.18 (± 72.08)	64.37 (± 72.44)	5.5 (± 7.54)	19.08 (± 27.19)

Scenario	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic bacteria	Sediment bacteria	Meiobenthos
No Climate change - 2010 context - SQ	0.29 (± 0.03)	1.23 (± 0.01)	0.85 (± 0.49)	0.8 (± 0.06)	5.16 (± 0.9)	2.89 (± 0.08)	0.69 (± 0.07)
2010 coastal context - Cap ecosystem take	15.62 (± 24.7)	57.77 (± 97.3)	12.59 (± 20.92)	15.12 (± 24.81)	8.54 (± 10.69)	242.91 (± 406.14)	67.88 (± 114.04)
2010 coastal context - Centralised mgmt.	15.76 (± 24.47)	57.3 (± 96.03)	12.61 (± 20.92)	15.07 (± 24.7)	9.12 (± 10.26)	241.85 (± 402.41)	67.72 (± 113.47)
2010 coastal context - FewMPA	16.09 (± 24.99)	57.63 (± 96.6)	12.61 (± 20.93)	15.26 (± 25)	9.21 (± 10.37)	251.2 (± 418.05)	69.77 (± 116.92)
2010 coastal context - Fragmented mgmt	15.81 (± 24.54)	57.98 (± 97.17)	12.53 (± 20.79)	15.05 (± 24.65)	9.12 (± 10.25)	241.57 (± 401.8)	67.65 (± 113.34)
2010 coastal context - ManyMPA	15.66 (± 24.32)	56.46 (± 94.64)	12.52 (± 20.77)	14.94 (± 24.48)	9.07 (± 10.21)	238.04 (± 396.1)	66.84 (± 112)
2010 coastal context - Seasons	15.66 (± 24.31)	56.53 (± 94.77)	12.54 (± 20.81)	14.96 (± 24.51)	9.07 (± 10.21)	238.26 (± 396.48)	66.91 (± 112.13)
2010 coastal context - SlowAssess	15.05 (± 25.12)	57.27 (± 96.38)	12.57 (± 20.91)	15.08 (± 24.68)	9.72 (± 9.64)	239.64 (± 405.63)	67.39 (± 113.89)
2010 coastal context - Integrated Mgmt (IM)	15.97 (± 24.34)	41.8 (± 69.85)	10.68 (± 17.69)	15.35 (± 25.04)	26.73 (± 32.48)	38.47 (± 62.72)	22.47 (± 37.89)
Cumulative impacts - 2010 Status Quo (SQ)	10.47 (± 16.83)	46.93 (± 78.25)	12.73 (± 21.12)	15.87 (± 26.01)	17.14 (± 22.36)	105.05 (± 172.63)	51.94 (± 87.13)

Cumulative impacts - Cap ecosystem take	10.38 (± 16.87)	46.52 (± 78.03)	12.71 (± 21.1)	15.81 (± 25.95)	16.51 (± 22.84)	103.85 (± 171.98)	51.64 (± 86.9)
Cumulative impacts - Centralised mgmt.	10.43 (± 16.76)	46.18 (± 76.97)	12.72 (± 21.11)	15.76 (± 25.83)	17.09 (± 22.28)	103.62 (± 170.2)	51.54 (± 86.45)
Cumulative impacts - FewMPA	10.65 (± 17.11)	46.45 (± 77.43)	12.73 (± 21.12)	15.96 (± 26.15)	17.26 (± 22.52)	107.62 (± 176.83)	53.11 (± 89.08)
Cumulative impacts - Fragmented mgmt	10.46 (± 16.8)	46.73 (± 77.89)	12.64 (± 20.97)	15.74 (± 25.77)	17.09 (± 22.27)	103.51 (± 169.94)	51.49 (± 86.35)
Cumulative impacts - ManyMPA	10.36 (± 16.65)	45.5 (± 75.86)	12.63 (± 20.95)	15.62 (± 25.6)	17.01 (± 22.18)	101.99 (± 167.54)	50.87 (± 85.33)
Cumulative impacts - Seasons	10.36 (± 16.65)	45.57 (± 75.96)	12.65 (± 20.99)	15.65 (± 25.63)	17.01 (± 22.19)	102.08 (± 167.7)	50.93 (± 85.43)
Cumulative impacts - SlowAssess	10.78 (± 16.47)	46.45 (± 77)	12.68 (± 21.1)	15.77 (± 25.81)	16.54 (± 22.82)	107.29 (± 167.63)	52.3 (± 85.9)
Cumulative impacts - IM	6 (± 5.94)	33.97 (± 55.75)	10.78 (± 17.85)	16.05 (± 26.18)	47.98 (± 72.81)	18.27 (± 25)	17.39 (± 28.62)
Expanded LTL fishery - IM	15.78 (± 24.5)	57.21 (± 95.88)	12.54 (± 20.8)	15.04 (± 24.64)	9.09 (± 10.23)	248.6 (± 413.62)	67.54 (± 113.17)
New mesopelgic fishery - IM	15.78 (± 24.5)	57.2 (± 95.89)	12.54 (± 20.8)	15.03 (± 24.64)	9.09 (± 10.23)	248.55 (± 413.66)	67.54 (± 113.17)
Extreme climate events - IM	15.83 (± 24.58)	58.33 (± 97.8)	12.63 (± 20.95)	15.19 (± 24.89)	9.14 (± 10.3)	245.52 (± 408.69)	68.32 (± 114.5)
Blooms - IM	15.84 (± 24.61)	58.64 (± 98.33)	12.62 (± 20.94)	15.17 (± 24.86)	9.14 (± 10.3)	245.26 (± 408.2)	68.24 (± 114.36)
Primary production regime shift - IM	9.47 (± 13.56)	56.9 (± 95.32)	11.17 (± 18.44)	15.4 (± 25.27)	9.36 (± 10.67)	262.95 (± 438.86)	81.09 (± 136.62)
Fish kills - IM	15.8 (± 24.54)	57.91 (± 97.08)	12.65 (± 20.99)	15.15 (± 24.83)	9.14 (± 10.28)	244.01 (± 406.05)	68.02 (± 113.98)
Range extensions - IM	15.81 (± 24.55)	57.83 (± 96.94)	12.61 (± 20.92)	15.13 (± 24.79)	9.14 (± 10.28)	244.36 (± 406.53)	68.09 (± 114.09)
Gear switching allowed - IM	15.67 (± 24.33)	56.5 (± 94.71)	12.54 (± 20.8)	14.96 (± 24.51)	9.08 (± 10.22)	238.3 (± 396.55)	66.92 (± 112.14)
High compliance - IM	15.74 (± 24.43)	57.1 (± 95.67)	12.53 (± 20.79)	15.02 (± 24.6)	9.12 (± 10.25)	241.24 (± 401.28)	67.59 (± 113.23)
Low Compliance - IM	15.84 (± 24.59)	58.46 (± 97.96)	12.63 (± 20.96)	15.2 (± 24.91)	9.15 (± 10.3)	245.71 (± 408.77)	68.35 (± 114.52)
Flexible fisher behaviour - IM	15.78 (± 24.5)	57.66 (± 96.66)	12.55 (± 20.83)	15.07 (± 24.7)	9.12 (± 10.26)	242.1 (± 402.87)	67.73 (± 113.5)
Increased fishing pressure drivers - IM	15.83 (± 24.58)	58.23 (± 97.63)	12.62 (± 20.94)	15.18 (± 24.87)	9.14 (± 10.3)	245.19 (± 408.12)	68.24 (± 114.37)
High Cost, Low Values - IM	15.66 (± 24.32)	56.45 (± 94.63)	12.52 (± 20.78)	14.94 (± 24.49)	9.07 (± 10.22)	238.13 (± 396.25)	66.88 (± 112.08)
Low Costs, High Values - IM	15.41 (± 24.82)	57.31 (± 96.98)	12.57 (± 20.9)	15.06 (± 24.75)	7.93 (± 11.17)	240.62 (± 404.16)	67.51 (± 113.71)
Standard Markets - IM	15.83 (± 24.58)	58.23 (± 97.63)	12.62 (± 20.94)	15.18 (± 24.87)	9.14 (± 10.3)	245.19 (± 408.12)	68.24 (± 114.37)
Technology Creep - IM	15.72 (± 24.41)	56.94 (± 95.47)	12.55 (± 20.82)	15 (± 24.58)	9.09 (± 10.23)	239.32 (± 398.28)	67.24 (± 112.68)
No Acclimation - 2010 coastal context - IM	7.1 (± 11.47)	27.49 (± 44.28)	11.8 (± 19.64)	14.38 (± 23.18)	10.22 (± 3.68)	109.53 (± 105.36)	30.89 (± 51.87)
No Acclimation - Cumulative impacts - SQ	18.04 (± 27.54)	38 (± 62.14)	13.94 (± 23.24)	14.23 (± 23.02)	4.9 (± 2.64)	637.98 (± 706.59)	93.75 (± 156.61)

Scenario	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	17.09 (± 3.09)	11.95 (± 1.38)
2010 coastal context - Cap ecosystem take	146.5 (± 252.32)	10.41 (± 14.7)
2010 coastal context - Centralised mgmt.	230.24 (± 397.37)	15.62 (± 23.69)
2010 coastal context - FewMPA	236.45 (± 408.09)	15.77 (± 23.91)
2010 coastal context - Fragmented mgmt	230.64 (± 398.06)	15.64 (± 23.74)
2010 coastal context - ManyMPA	224.71 (± 387.82)	15.3 (± 23.19)

Scenario	Labile detritus	Refractory detritus
2010 coastal context - Seasons	224.73 (± 387.86)	15.29 (± 23.18)
2010 coastal context - SlowAssess	676.93 (± 1170.88)	64.63 (± 107.88)
2010 coastal context - Integrated Mgmt (IM)	473.78 (± 800.22)	84.23 (± 115.18)
Cumulative impacts - 2010 Status Quo (SQ)	705.29 (± 1204.3)	76.66 (± 105.83)
Cumulative impacts - Cap ecosystem take	447.4 (± 757.76)	52.3 (± 64.52)
Cumulative impacts - Centralised mgmt.	700.25 (± 1195.82)	76.1 (± 105.18)
Cumulative impacts - FewMPA	719.2 (± 1228.04)	76.9 (± 106.11)
Cumulative impacts - Fragmented mgmt	701.46 (± 1197.93)	76.22 (± 105.41)
Cumulative impacts - ManyMPA	683.49 (± 1167.04)	74.56 (± 102.92)
Cumulative impacts - Seasons	683.56 (± 1167.16)	74.56 (± 102.88)
Cumulative impacts - SlowAssess	246.63 (± 410.32)	25.55 (± 23.09)
Cumulative impacts - IM	246.54 (± 247.99)	100.56 (± 131.12)
Expanded LTL fishery - IM	234.91 (± 405.43)	15.75 (± 23.9)
New mesopelgic fishery - IM	234.91 (± 405.43)	15.75 (± 23.9)
Extreme climate events - IM	230.85 (± 398.41)	15.66 (± 23.73)
Blooms - IM	229.95 (± 396.84)	15.62 (± 23.66)
Primary production regime shift - IM	231.4 (± 399.27)	15.89 (± 23.66)
Fish kills - IM	231.88 (± 400.2)	15.72 (± 23.85)
Range extensions - IM	229.94 (± 396.84)	15.61 (± 23.66)
Gear switching allowed - IM	224.62 (± 387.66)	15.29 (± 23.17)
High compliance - IM	233.34 (± 402.75)	15.8 (± 24.01)
Low Compliance - IM	232.12 (± 400.6)	15.76 (± 23.89)
Flexible fisher behaviour - IM	228.74 (± 394.77)	15.54 (± 23.56)
Increased fishing pressure drivers - IM	231.88 (± 400.2)	15.73 (± 23.84)
High Cost, Low Values - IM	224.53 (± 387.5)	15.28 (± 23.16)
Low Costs, High Values - IM	61.12 (± 104.44)	5.09 (± 5.71)
Standard Markets - IM	231.88 (± 400.2)	15.73 (± 23.84)
Technology Creep - IM	225.76 (± 389.63)	15.37 (± 23.29)
No Acclimation - 2010 coastal context - IM	23189.11 (± 40164.19)	306.63 (± 529.35)
No Acclimation - Cumulative impacts - SQ	33580.76 (± 58163.55)	267.08 (± 462.37)

Table A. 9: Mean relative biomass (± s.e.) 2065-2070 of each group in Atlantis-SEAP for each strategy-scenario combination under RCP 8.5. Biomass is relative to 2010 model values.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.76 (± 0.24)	1.55 (± 0.75)	1.5 (± 1.32)	11.24 (± 4.75)	5.87 (± 8.46)	0.39 (± 0.21)	3.03 (± 2.64)	6.43 (± 2.29)
2010 coastal context - Cap ecosystem take	1.9 (± 0.75)	1.34 (± 0.65)	2.31 (± 0.12)	12.96 (± 5.87)	0.87 (± 0.88)	0.2 (± 0.12)	1.39 (± 0.92)	9.93 (± 8.53)
2010 coastal context - Centralised mgmt.	2.42 (± 1.37)	1.77 (± 0.98)	2.19 (± 0.06)	15.09 (± 4.9)	0.97 (± 0.76)	0.37 (± 0.27)	2.82 (± 1.61)	11.37 (± 8.01)
2010 coastal context - FewMPA	2.28 (± 1.24)	0.92 (± 0.14)	1.86 (± 0.31)	13.69 (± 3.16)	0.65 (± 0.45)	0.07 (± 0.05)	0.75 (± 0.39)	9.98 (± 5.85)
2010 coastal context - Fragmented mgmt	2.43 (± 1.39)	1.61 (± 1.1)	2.22 (± 0.11)	14.84 (± 4.75)	1 (± 0.82)	0.13 (± 0.09)	0.96 (± 0.64)	11.17 (± 7.88)
2010 coastal context - ManyMPA	2.42 (± 1.38)	0.53 (± 0.8)	1.24 (± 0)	15.44 (± 5.13)	0.48 (± 0.48)	0.43 (± 0.35)	5.13 (± 0.86)	11.66 (± 8.36)
2010 coastal context - Seasons	2.41 (± 1.37)	0.79 (± 0.48)	1.26 (± 0.02)	15.1 (± 4.91)	0.41 (± 0.34)	0.42 (± 0.35)	4.34 (± 1.78)	11.39 (± 8.06)
2010 coastal context - SlowAssess	0.92 (± 1.29)	3.33 (± 2.82)	1.03 (± 1.08)	13.42 (± 5.57)	0.77 (± 1.1)	0.51 (± 0.29)	2.45 (± 1.11)	7.81 (± 10.43)
2010 coastal context - Integrated Mgmt (IM)	0.93 (± 1.46)	4.16 (± 5.93)	0.39 (± 0.4)	15.65 (± 2.08)	1.03 (± 1.46)	1.95 (± 1.62)	6.35 (± 7.7)	10.63 (± 6.86)
Cumulative impacts - 2010 Status Quo (SQ)	0.23 (± 0.1)	1.19 (± 1.23)	0.42 (± 0.06)	9.52 (± 1.15)	0.25 (± 0.13)	0.26 (± 0.21)	2.18 (± 1.87)	2 (± 0.45)
Cumulative impacts - Cap ecosystem take	0.21 (± 0.12)	1.48 (± 1.5)	0.44 (± 0.06)	8.15 (± 2.23)	0.23 (± 0.15)	0.19 (± 0.2)	1.93 (± 2.15)	1.73 (± 0.67)
Cumulative impacts - Centralised mgmt.	0.23 (± 0.1)	1.68 (± 1.76)	0.41 (± 0.06)	9.52 (± 1.03)	0.26 (± 0.13)	0.28 (± 0.19)	3.39 (± 2.68)	2.01 (± 0.48)
Cumulative impacts - FewMPA	0.22 (± 0.08)	1.09 (± 0.87)	0.35 (± 0.1)	8.92 (± 2.02)	0.29 (± 0.31)	0.07 (± 0.06)	2.07 (± 1.58)	1.83 (± 0.25)
Cumulative impacts - Fragmented mgmt	0.23 (± 0.1)	1.45 (± 1.78)	0.42 (± 0.07)	9.38 (± 1.07)	0.27 (± 0.14)	0.12 (± 0.1)	2.61 (± 2.06)	1.98 (± 0.46)
Cumulative impacts - ManyMPA	0.23 (± 0.1)	0.13 (± 0.04)	0.23 (± 0.03)	9.73 (± 1)	0.11 (± 0.05)	0.35 (± 0.29)	6.6 (± 5.28)	2.06 (± 0.51)
Cumulative impacts - Seasons	0.23 (± 0.1)	0.8 (± 0.93)	0.24 (± 0.03)	9.53 (± 1.03)	0.12 (± 0.07)	0.34 (± 0.27)	4.04 (± 3.05)	2.01 (± 0.48)
Cumulative impacts - SlowAssess	1.73 (± 1.8)	1.79 (± 1.98)	1.48 (± 0.96)	11.19 (± 3.24)	0.71 (± 0.84)	0.13 (± 0.22)	2.3 (± 2.63)	5.51 (± 3.82)
Cumulative impacts - IM	0.79 (± 0.48)	0.77 (± 0.53)	0.58 (± 0.39)	8.44 (± 5.32)	0.69 (± 0.45)	0.67 (± 1.13)	4.72 (± 2.48)	4 (± 2.62)
Expanded LTL fishery - IM	2.44 (± 1.4)	1.72 (± 1)	2.14 (± 0.04)	15 (± 4.9)	1.07 (± 0.9)	0.2 (± 0.19)	2.73 (± 0.64)	11.32 (± 8.01)
New mesopelgic fishery - IM	2.44 (± 1.39)	1.65 (± 1.13)	2.17 (± 0.07)	14.95 (± 4.99)	1.08 (± 0.89)	0.04 (± 0.05)	2.4 (± 0.34)	11.29 (± 8.04)
Extreme climate events - IM	2.42 (± 1.38)	1.51 (± 0.97)	2.23 (± 0.11)	15.17 (± 5.02)	1.02 (± 0.89)	0.15 (± 0.11)	1.48 (± 0.4)	11.45 (± 8.16)
Blooms - IM	2.42 (± 1.38)	1.45 (± 0.97)	2.24 (± 0.1)	15.09 (± 4.89)	1.01 (± 0.83)	0.34 (± 0.24)	1.29 (± 0.93)	11.36 (± 7.93)
Primary production regime shift - IM	2.44 (± 1.39)	1.81 (± 1.23)	2.2 (± 0.09)	14.8 (± 4.97)	0.95 (± 0.78)	0.17 (± 0.11)	1.91 (± 1.76)	11.19 (± 7.98)
Fish kills - IM	2.42 (± 1.37)	1.53 (± 1.01)	2.22 (± 0.09)	15.18 (± 4.75)	0.95 (± 0.77)	0.13 (± 0.14)	1.35 (± 0.9)	11.41 (± 7.91)
Range extensions - IM	2.43 (± 1.41)	1.86 (± 0.28)	2.22 (± 0.08)	14.69 (± 4.99)	0.97 (± 0.82)	0.19 (± 0.15)	1.32 (± 0.31)	11.11 (± 7.91)
Gear switching allowed - IM	2.41 (± 1.39)	2.23 (± 0.79)	1.24 (± 0.04)	15.23 (± 5.32)	0.5 (± 0.42)	0.41 (± 0.34)	4.29 (± 0.4)	11.56 (± 8.39)
High compliance - IM	2.42 (± 1.38)	1.65 (± 1.09)	2.17 (± 0.08)	14.95 (± 4.8)	1.04 (± 0.85)	0.33 (± 0.25)	2.72 (± 2.16)	11.26 (± 7.95)
Low Compliance - IM	2.45 (± 1.41)	1.18 (± 0.86)	2.31 (± 0.09)	15.13 (± 5.01)	1.43 (± 1.15)	0.31 (± 0.25)	1.01 (± 0.5)	11.43 (± 8.13)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores fish	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
Flexible fisher behaviour - IM	2.33 (± 1.32)	1.56 (± 0.85)	1.99 (± 0.06)	15.01 (± 4.63)	0.96 (± 0.8)	0.09 (± 0.12)	2.96 (± 2.09)	11.26 (± 7.74)
Increased fishing pressure drivers - IM	2.41 (± 1.37)	1.47 (± 0.98)	2.21 (± 0.08)	15.03 (± 4.7)	0.96 (± 0.79)	0.3 (± 0.24)	1.63 (± 0.9)	11.29 (± 7.79)
High Cost, Low Values - IM	2.42 (± 1.38)	0.32 (± 0.21)	1.24 (± 0.01)	15.28 (± 5.08)	0.51 (± 0.45)	0.44 (± 0.36)	2.53 (± 1.53)	11.54 (± 8.29)
Low Costs, High Values - IM	1.39 (± 0.91)	1.22 (± 0.97)	2.42 (± 0.32)	10.88 (± 8.58)	0.79 (± 1.03)	0.05 (± 0.04)	1.12 (± 0.97)	8.57 (± 9.84)
Standard Markets - IM	2.41 (± 1.37)	1.47 (± 0.98)	2.21 (± 0.08)	15.03 (± 4.7)	0.96 (± 0.79)	0.31 (± 0.22)	1.9 (± 1.06)	11.29 (± 7.79)
Technology Creep - IM	2.38 (± 1.35)	1.8 (± 1.02)	1.78 (± 0.17)	15.15 (± 4.85)	1.01 (± 0.93)	0.04 (± 0.03)	2.19 (± 1.32)	11.41 (± 8.06)
No Acclimation - 2010 coastal context - IM	0.82 (± 0.52)	0.8 (± 0.79)	0.99 (± 0.67)	6.49 (± 4.9)	0.67 (± 0.97)	0.13 (± 0.13)	0.49 (± 0.22)	5.02 (± 5.58)
No Acclimation - Cumulative impacts - SQ	1.16 (± 0.13)	1.4 (± 1.97)	2.75 (± 1.88)	12.25 (± 14.43)	0.48 (± 0.57)	0.07 (± 0.07)	0.22 (± 0.24)	10.93 (± 15.53)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.3 (± 0.27)	0.36 (± 0.08)	4.81 (± 6.1)	0.8 (± 0.7)	9.44 (± 4.72)	7.95 (± 7.11)	1.07 (± 1.24)	4.98 (± 7.79)
2010 coastal context - Cap ecosystem take	0.09 (± 0.05)	0.07 (± 0.05)	0.34 (± 0.19)	0.68 (± 0.72)	7.46 (± 5.04)	3.24 (± 3.95)	0.5 (± 0.56)	1.72 (± 2.77)
2010 coastal context - Centralised mgmt.	0.12 (± 0.09)	0.06 (± 0.06)	0.4 (± 0.26)	1.36 (± 1.51)	8.31 (± 4.54)	5.53 (± 5.3)	0.98 (± 1.18)	2.68 (± 4.05)
2010 coastal context - FewMPA	0.05 (± 0.03)	0.01 (± 0.01)	0.05 (± 0.02)	0.3 (± 0.2)	2.38 (± 1.32)	2.29 (± 3.14)	0.21 (± 0.16)	1.3 (± 2.12)
2010 coastal context - Fragmented mgmt	0.1 (± 0.12)	0.02 (± 0.01)	0.39 (± 0.26)	0.26 (± 0.15)	8.03 (± 4.71)	2.79 (± 3.34)	0.16 (± 0.13)	1.5 (± 2.3)
2010 coastal context - ManyMPA	0.09 (± 0.06)	0.37 (± 0.19)	0.53 (± 0.38)	2.12 (± 1.74)	10.02 (± 5.48)	11.38 (± 11.47)	1.47 (± 1.44)	5.7 (± 8.57)
2010 coastal context - Seasons	0.07 (± 0.07)	0.37 (± 0.19)	0.54 (± 0.41)	1.86 (± 1.93)	10.17 (± 5.44)	7.43 (± 4.72)	1.29 (± 1.55)	3.2 (± 4.28)
2010 coastal context - SlowAssess	0.05 (± 0.01)	0.52 (± 0.87)	5.15 (± 4.73)	1.37 (± 1.23)	11.05 (± 2.39)	11.66 (± 6.16)	0.53 (± 0.37)	2.05 (± 3.34)
2010 coastal context - Integrated Mgmt (IM)	0.07 (± 0.03)	2.28 (± 2.63)	4.96 (± 8.1)	2.71 (± 2.96)	12.09 (± 6.95)	26.65 (± 29.72)	0.92 (± 0.79)	2.24 (± 3.41)
Cumulative impacts - 2010 Status Quo (SQ)	0.06 (± 0.03)	0.38 (± 0.16)	0 (± 0)	0.93 (± 0.67)	4.28 (± 2.11)	7.5 (± 5.05)	0.26 (± 0.15)	0.52 (± 0.82)
Cumulative impacts - Cap ecosystem take	0.05 (± 0.04)	2.78 (± 3.14)	0 (± 0)	0.82 (± 0.81)	3.92 (± 2.54)	6.4 (± 5.94)	0.22 (± 0.19)	0.53 (± 0.87)
Cumulative impacts - Centralised mgmt.	0.06 (± 0.05)	1.38 (± 0.11)	0 (± 0)	1.42 (± 0.97)	4.66 (± 2.44)	11.79 (± 7.91)	0.39 (± 0.23)	0.73 (± 1.15)
Cumulative impacts - FewMPA	0.03 (± 0.02)	0.5 (± 0.7)	0 (± 0)	0.86 (± 0.58)	1.37 (± 0.75)	7.33 (± 5.28)	0.24 (± 0.15)	0.4 (± 0.61)
Cumulative impacts - Fragmented mgmt	0.06 (± 0.03)	1.25 (± 0.28)	0 (± 0)	1.08 (± 0.77)	4.56 (± 2.58)	9.13 (± 6.68)	0.3 (± 0.2)	0.53 (± 0.82)
Cumulative impacts - ManyMPA	0.09 (± 0.11)	11.71 (± 12.3)	0 (± 0)	2.72 (± 1.98)	5.68 (± 3.02)	23.87 (± 19.98)	0.77 (± 0.57)	1.09 (± 1.58)
Cumulative impacts - Seasons	0.06 (± 0.05)	11.99 (± 13.1)	0 (± 0)	1.68 (± 1.12)	5.83 (± 3.09)	14.34 (± 10.41)	0.47 (± 0.29)	0.76 (± 1.15)
Cumulative impacts - SlowAssess	0.06 (± 0.02)	0.54 (± 0.56)	0 (± 0)	0.94 (± 1.06)	3.76 (± 3.02)	5.83 (± 8.84)	0.34 (± 0.27)	0.7 (± 1.01)
Cumulative impacts - IM	0.08 (± 0.09)	9.44 (± 7.81)	0 (± 0)	1.55 (± 0.85)	3.75 (± 3.34)	9.2 (± 8.93)	0.62 (± 0.31)	1.28 (± 1.06)
Expanded LTL fishery - IM	0.09 (± 0.06)	0.19 (± 0.14)	0.45 (± 0.31)	1.16 (± 1.01)	8.69 (± 4.76)	5.97 (± 6.03)	0.81 (± 0.82)	2.99 (± 4.51)
New mesopelgic fishery - IM	0.09 (± 0.05)	0.19 (± 0.24)	0.47 (± 0.28)	0.98 (± 0.79)	8.87 (± 4.71)	5.27 (± 5.2)	0.68 (± 0.66)	2.62 (± 3.91)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Extreme climate events - IM	0.13 (± 0.11)	0.03 (± 0.03)	0.35 (± 0.24)	0.55 (± 0.33)	7.62 (± 3.72)	4.03 (± 4.93)	0.38 (± 0.28)	2.18 (± 3.44)
Blooms - IM	0.13 (± 0.09)	0.02 (± 0.01)	0.37 (± 0.28)	0.36 (± 0.28)	7.58 (± 3.85)	4.13 (± 5.37)	0.23 (± 0.22)	2.3 (± 3.63)
Primary production regime shift - IM	0.13 (± 0.11)	0.06 (± 0.06)	0.38 (± 0.22)	0.67 (± 0.59)	8.48 (± 5.4)	7.16 (± 10.89)	0.46 (± 0.44)	4.26 (± 7.13)
Fish kills - IM	0.13 (± 0.11)	0.02 (± 0.02)	0.33 (± 0.2)	0.51 (± 0.35)	7.74 (± 4.24)	4.49 (± 6.44)	0.35 (± 0.28)	2.6 (± 4.29)
Range extensions - IM	0.13 (± 0.09)	0.04 (± 0.02)	0.38 (± 0.3)	0.45 (± 0.21)	7.19 (± 4.24)	3.14 (± 3.19)	0.3 (± 0.21)	1.58 (± 2.34)
Gear switching allowed - IM	0.07 (± 0.04)	0.36 (± 0.19)	0.51 (± 0.39)	1.67 (± 1.25)	9.71 (± 5)	9.26 (± 8.69)	1.14 (± 1.06)	4.52 (± 6.63)
High compliance - IM	0.12 (± 0.1)	0.08 (± 0.07)	0.33 (± 0.16)	1.37 (± 1.42)	8.28 (± 4.95)	7.03 (± 9.49)	1 (± 1.08)	3.9 (± 6.44)
Low Compliance - IM	0.1 (± 0.07)	0.02 (± 0.04)	0.3 (± 0.23)	0.4 (± 0.27)	7.11 (± 3.95)	3.04 (± 4.12)	0.28 (± 0.22)	1.72 (± 2.79)
Flexible fisher behaviour - IM	0.12 (± 0.11)	0.07 (± 0.05)	0.43 (± 0.31)	1.45 (± 1.83)	8.42 (± 4.46)	4.4 (± 2.25)	1.03 (± 1.42)	1.77 (± 2.28)
Increased fishing pressure drivers - IM	0.1 (± 0.06)	0.06 (± 0.05)	0.32 (± 0.19)	0.67 (± 0.5)	7.67 (± 3.96)	4.92 (± 6.79)	0.47 (± 0.39)	2.79 (± 4.58)
High Cost, Low Values - IM	0.02 (± 0.01)	0.38 (± 0.19)	0.57 (± 0.44)	0.85 (± 0.63)	10.29 (± 5.52)	4.07 (± 2.17)	0.55 (± 0.55)	1.55 (± 1.72)
Low Costs, High Values - IM	0.05 (± 0.03)	0.1 (± 0.08)	0.35 (± 0.19)	0.54 (± 0.49)	7.26 (± 6.14)	3.45 (± 5.12)	0.39 (± 0.37)	2.01 (± 3.39)
Standard Markets - IM	0.12 (± 0.1)	0.03 (± 0.04)	0.32 (± 0.19)	0.82 (± 0.65)	7.67 (± 3.96)	5.52 (± 7.55)	0.58 (± 0.51)	3.11 (± 5.11)
Technology Creep - IM	0.07 (± 0.04)	0.35 (± 0.22)	0.52 (± 0.39)	0.65 (± 0.19)	9.35 (± 4.79)	4.46 (± 3.5)	0.4 (± 0.23)	2 (± 2.62)
No Acclimation - 2010 coastal context - IM	0.06 (± 0.03)	0.02 (± 0.03)	0.11 (± 0.07)	0.2 (± 0.14)	5.43 (± 6.07)	1.43 (± 1.89)	0.14 (± 0.12)	0.8 (± 1.29)
No Acclimation - Cumulative impacts - SQ	0.18 (± 0.23)	0.01 (± 0.01)	5.29 (± 9.08)	0.08 (± 0.08)	4.18 (± 5.44)	0.85 (± 1.35)	0.06 (± 0.06)	0.51 (± 0.87)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	6.3 (± 7.06)	0.72 (± 0.58)	7.12 (± 6.95)	1.03 (± 1.04)	3.61 (± 5.81)	27.1 (± 11.01)	3.24 (± 0.31)	2.13 (± 0.03)
2010 coastal context - Cap ecosystem take	4.63 (± 3.8)	2.66 (± 4.1)	3.17 (± 2.95)	1.19 (± 1.08)	4.44 (± 5.32)	40.91 (± 49.9)	1.25 (± 0.68)	1.97 (± 0.37)
2010 coastal context - Centralised mgmt.	8.61 (± 7.15)	5.45 (± 8.62)	5.58 (± 4.03)	2.27 (± 2.2)	5.46 (± 5.32)	44.02 (± 48.3)	1.28 (± 0.67)	2 (± 0.41)
2010 coastal context - FewMPA	2.41 (± 2.22)	0.88 (± 1.14)	1.99 (± 2.39)	0.57 (± 0.46)	2.68 (± 2.52)	37.01 (± 36.22)	1.18 (± 0.62)	1.44 (± 0.27)
2010 coastal context - Fragmented mgmt	2.32 (± 2.53)	0.43 (± 0.31)	2.22 (± 2.65)	0.51 (± 0.5)	5.39 (± 5.43)	43.35 (± 47.7)	1.26 (± 0.67)	1.92 (± 0.37)
2010 coastal context - ManyMPA	14.41 (± 9.63)	7.46 (± 11.1)	10.51 (± 8.24)	3.65 (± 2.68)	1.25 (± 1.17)	45.4 (± 50.41)	1.08 (± 0.55)	1.53 (± 0.16)
2010 coastal context - Seasons	11.31 (± 8.65)	7.23 (± 11.44)	7.37 (± 3.37)	3.01 (± 2.79)	1.87 (± 2)	44.18 (± 48.69)	0.99 (± 0.52)	1.53 (± 0.27)
2010 coastal context - SlowAssess	4.31 (± 2.9)	1.02 (± 0.73)	9.87 (± 7.86)	0.6 (± 0.83)	4.12 (± 6.32)	46.66 (± 45.81)	0.88 (± 1)	1.55 (± 0.59)
2010 coastal context - Integrated Mgmt (IM)	8.29 (± 6.71)	2.07 (± 2.17)	15.84 (± 12.71)	0.78 (± 0.78)	1.39 (± 2.29)	51.03 (± 49.93)	1.97 (± 1.26)	1.49 (± 0.38)
Cumulative impacts - 2010 Status Quo (SQ)	2.88 (± 3.03)	0.62 (± 0.4)	3.74 (± 1.27)	0.1 (± 0.1)	2.94 (± 4.46)	21.69 (± 5.28)	0.26 (± 0.01)	1.03 (± 0.02)
Cumulative impacts - Cap ecosystem take	2.66 (± 3.42)	0.53 (± 0.49)	3.12 (± 1.87)	0.09 (± 0.11)	3.15 (± 4.93)	18.33 (± 5.65)	0.26 (± 0)	1.01 (± 0.06)
Cumulative impacts - Centralised mgmt.	4.37 (± 4.16)	0.96 (± 0.61)	5.77 (± 2.59)	0.16 (± 0.13)	3.39 (± 5.12)	21.75 (± 5.4)	0.27 (± 0.01)	1.02 (± 0.07)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
Cumulative impacts - FewMPA	2.6 (± 2.24)	0.59 (± 0.4)	3.57 (± 2.15)	0.09 (± 0.07)	1.66 (± 2.44)	19.98 (± 4.66)	0.25 (± 0)	0.74 (± 0.03)
Cumulative impacts - Fragmented mgmt	3.32 (± 3.03)	0.73 (± 0.51)	4.38 (± 2.68)	0.12 (± 0.1)	3.39 (± 5.2)	21.37 (± 5.03)	0.26 (± 0.01)	0.98 (± 0.04)
Cumulative impacts - ManyMPA	7.98 (± 6.38)	1.89 (± 1.46)	11.67 (± 9.25)	0.29 (± 0.23)	0.78 (± 1.14)	22.2 (± 5.4)	0.23 (± 0.01)	0.79 (± 0.04)
Cumulative impacts - Seasons	5.04 (± 4.25)	1.15 (± 0.77)	7 (± 4.32)	0.18 (± 0.14)	1.24 (± 1.9)	21.75 (± 5.28)	0.21 (± 0)	0.78 (± 0.03)
Cumulative impacts - SlowAssess	3.82 (± 3.83)	1.44 (± 1.45)	2.72 (± 3.21)	0.42 (± 0.4)	4.74 (± 4.7)	19.09 (± 6.21)	0.66 (± 0.38)	1.39 (± 0.35)
Cumulative impacts - IM	6.7 (± 2.5)	2.73 (± 3.03)	5.04 (± 2.54)	1.07 (± 0.77)	1.22 (± 1.89)	12.44 (± 3.7)	2.51 (± 2.34)	1.39 (± 0.47)
Expanded LTL fishery - IM	7.8 (± 5.37)	4.18 (± 6.29)	5.59 (± 4.34)	1.99 (± 1.53)	5.77 (± 5.64)	43.88 (± 48.34)	1.28 (± 0.67)	2 (± 0.41)
New mesopelgic fishery - IM	6.64 (± 4.35)	3.43 (± 5.09)	4.85 (± 3.71)	1.68 (± 1.22)	5.8 (± 5.59)	43.81 (± 48.41)	1.27 (± 0.67)	1.93 (± 0.37)
Extreme climate events - IM	4.27 (± 3.42)	1.64 (± 2.16)	3.49 (± 3.72)	1.02 (± 0.72)	4.92 (± 4.85)	44.47 (± 49.16)	1.24 (± 0.63)	1.99 (± 0.34)
Blooms - IM	3.4 (± 4.15)	0.57 (± 0.39)	3.29 (± 4.27)	0.74 (± 0.83)	5.06 (± 4.83)	43.82 (± 47.8)	1.24 (± 0.63)	2 (± 0.3)
Primary production regime shift - IM	6.41 (± 8.18)	1.42 (± 1.33)	5.9 (± 8.56)	1.43 (± 1.65)	5.89 (± 6.44)	43.4 (± 47.98)	1.3 (± 0.74)	1.97 (± 0.3)
Fish kills - IM	4.38 (± 4.64)	1.32 (± 1.54)	3.8 (± 4.98)	1.01 (± 0.93)	4.84 (± 4.93)	44.02 (± 47.92)	1.24 (± 0.64)	2 (± 0.31)
Range extensions - IM	3.31 (± 2.09)	1.31 (± 1.75)	2.7 (± 2.34)	0.8 (± 0.45)	5.2 (± 4.98)	43.02 (± 47.47)	1.47 (± 0.64)	2.42 (± 0.89)
Gear switching allowed - IM	11.34 (± 6.96)	5.7 (± 8.39)	8.42 (± 6.13)	2.86 (± 1.94)	2.16 (± 2.31)	45 (± 50.25)	1.27 (± 0.68)	1.75 (± 0.32)
High compliance - IM	9.62 (± 8.16)	5.23 (± 7.93)	6.76 (± 7.1)	2.45 (± 2.18)	5.22 (± 5.77)	43.67 (± 48.05)	1.27 (± 0.68)	1.96 (± 0.33)
Low Compliance - IM	3.2 (± 2.91)	1.17 (± 1.52)	2.64 (± 3.14)	0.76 (± 0.61)	6.36 (± 6.13)	44.35 (± 48.98)	1.26 (± 0.68)	1.97 (± 0.3)
Flexible fisher behaviour - IM	8.32 (± 8.43)	6.15 (± 10.07)	4.84 (± 2.71)	2.29 (± 2.66)	5.46 (± 5.25)	43.36 (± 46.94)	1.27 (± 0.65)	1.98 (± 0.34)
Increased fishing pressure drivers - IM	5.35 (± 4.82)	2.09 (± 2.79)	4.32 (± 5.15)	1.28 (± 1.03)	4.67 (± 4.65)	43.48 (± 47.17)	1.24 (± 0.63)	2.01 (± 0.31)
High Cost, Low Values - IM	5.11 (± 2.45)	2.85 (± 4.32)	3.68 (± 0.64)	1.33 (± 0.89)	1.27 (± 1.27)	44.97 (± 49.96)	1.02 (± 0.54)	1.51 (± 0.22)
Low Costs, High Values - IM	4.13 (± 3.79)	1.86 (± 2.65)	3.15 (± 3.87)	1.01 (± 0.87)	4.2 (± 6.19)	38.35 (± 52.98)	1.26 (± 0.73)	1.93 (± 0.44)
Standard Markets - IM	6.3 (± 5.44)	2.69 (± 3.73)	4.94 (± 5.69)	1.53 (± 1.22)	4.67 (± 4.65)	43.48 (± 47.17)	1.24 (± 0.63)	2.01 (± 0.31)
Technology Creep - IM	4.46 (± 1.76)	1.72 (± 2.25)	3.72 (± 2.34)	1.08 (± 0.38)	5.66 (± 5.6)	44.27 (± 48.73)	1.3 (± 0.69)	1.84 (± 0.31)
No Acclimation - 2010 coastal context - IM	1.57 (± 1.34)	0.63 (± 0.85)	1.26 (± 1.43)	0.38 (± 0.29)	3.59 (± 5.48)	22.32 (± 30.22)	0.11 (± 0.05)	0.79 (± 1.13)
No Acclimation - Cumulative impacts - SQ	0.79 (± 1)	0.2 (± 0.22)	0.71 (± 1.06)	0.18 (± 0.2)	13.4 (± 11.83)	51.39 (± 80.49)	0.05 (± 0.04)	0.77 (± 1.07)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
No Climate change - 2010 context - SQ	6.24 (± 4.77)	0.54 (± 0.06)	1.81 (± 0.96)	0.41 (± 0.06)	6.2 (± 0.18)	1.62 (± 0.96)	0.99 (± 0.43)	0.51 (± 0.17)
2010 coastal context - Cap ecosystem take	219.82 (± 276.12)	0.47 (± 0.1)	3.9 (± 0.89)	1.72 (± 0.66)	2.35 (± 1.32)	0.21 (± 0.07)	1.29 (± 0.35)	0.03 (± 0.01)
2010 coastal context - Centralised mgmt.	252.54 (± 330.9)	0.48 (± 0.09)	3.59 (± 0.73)	1.75 (± 0.51)	2.77 (± 1.59)	0.18 (± 0.1)	1.08 (± 0.01)	0.03 (± 0.01)
2010 coastal context - FewMPA	156.64 (± 171.01)	0.46 (± 0.08)	1 (± 0.38)	0.01 (± 0.01)	2.2 (± 1.33)	0.18 (± 0.09)	0.7 (± 0.04)	0.03 (± 0.01)
2010 coastal context - Fragmented mgmt	239.38 (± 330.15)	0.48 (± 0.09)	5.1 (± 3.02)	1.64 (± 0.6)	2.46 (± 1.26)	0.18 (± 0.1)	1.08 (± 0.01)	0.03 (± 0.01)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Seabirds	Urchins	Pinnipeds	Abalone
2010 coastal context - ManyMPA	173.64 (± 295.96)	0.49 (± 0.08)	1.6 (± 2.56)	1.73 (± 0.52)	2.28 (± 1.22)	0.19 (± 0.1)	1.09 (± 0)	0.03 (± 0.01)
2010 coastal context - Seasons	55.38 (± 66.25)	0.49 (± 0.09)	0.42 (± 0.37)	2.02 (± 0.93)	2.21 (± 1.27)	0.19 (± 0.1)	1.1 (± 0)	0.03 (± 0.01)
2010 coastal context - SlowAssess	18.72 (± 8.87)	0.52 (± 0.03)	1.72 (± 1.94)	2.46 (± 1.55)	3.6 (± 2.3)	0.63 (± 0.42)	1.1 (± 0.04)	0.01 (± 0.01)
2010 coastal context - Integrated Mgmt (IM)	15.9 (± 5.02)	0.54 (± 0.08)	0.47 (± 0.55)	1.57 (± 1.24)	9.53 (± 3.11)	5.02 (± 6.74)	0.99 (± 0.16)	0.05 (± 0.09)
Cumulative impacts - 2010 Status Quo (SQ)	9.69 (± 4.96)	0.5 (± 0)	0.19 (± 0.11)	0.86 (± 0.14)	5.11 (± 1.09)	0.6 (± 0.2)	0.74 (± 0.03)	0 (± 0)
Cumulative impacts - Cap ecosystem take	9.48 (± 2.97)	0.49 (± 0.02)	0.16 (± 0.12)	0.88 (± 0.11)	4.92 (± 1.36)	0.8 (± 0.38)	0.89 (± 0.25)	0 (± 0)
Cumulative impacts - Centralised mgmt.	10.55 (± 4.1)	0.5 (± 0)	0.15 (± 0.1)	0.92 (± 0.05)	5.7 (± 1.49)	0.61 (± 0.2)	0.75 (± 0.03)	0 (± 0)
Cumulative impacts - FewMPA	7.34 (± 0.7)	0.48 (± 0)	0.05 (± 0.07)	0.01 (± 0)	4.58 (± 0.96)	0.59 (± 0.21)	0.49 (± 0.04)	0 (± 0)
Cumulative impacts - Fragmented mgmt	9.76 (± 4.82)	0.5 (± 0)	0.23 (± 0.24)	0.84 (± 0.1)	5.41 (± 1.66)	0.6 (± 0.21)	0.74 (± 0.02)	0 (± 0)
Cumulative impacts - ManyMPA	4.06 (± 6.54)	0.51 (± 0)	0.04 (± 0.07)	0.9 (± 0.07)	4.87 (± 1.29)	0.62 (± 0.2)	0.75 (± 0.03)	0 (± 0)
Cumulative impacts - Seasons	2.52 (± 0.63)	0.51 (± 0)	0.01 (± 0)	1.03 (± 0.21)	4.59 (± 1.33)	0.62 (± 0.21)	0.75 (± 0.03)	0 (± 0)
Cumulative impacts - SlowAssess	190.64 (± 236.16)	0.47 (± 0.07)	0.42 (± 0.27)	1.4 (± 1.16)	3.81 (± 2.93)	0.47 (± 0.38)	0.76 (± 0.05)	0.03 (± 0.04)
Cumulative impacts - IM	21.81 (± 28.87)	0.48 (± 0.04)	0.15 (± 0.17)	0.72 (± 0.81)	16.51 (± 20.07)	2.39 (± 2.64)	0.68 (± 0.09)	0.11 (± 0.13)
Expanded LTL fishery - IM	233.22 (± 294.24)	0.48 (± 0.09)	2.85 (± 0.79)	1.92 (± 0.74)	2.03 (± 1.27)	0.18 (± 0.1)	1.1 (± 0.01)	0.03 (± 0.01)
New mesopelgic fishery - IM	224.14 (± 300.85)	0.48 (± 0.09)	3.19 (± 1.12)	1.91 (± 0.73)	2.05 (± 1.29)	0.19 (± 0.1)	1.1 (± 0.01)	0.03 (± 0.01)
Extreme climate events - IM	262.99 (± 365.89)	0.47 (± 0.08)	5.11 (± 1.14)	1.78 (± 0.79)	2.12 (± 0.97)	0.18 (± 0.1)	1.07 (± 0.01)	0.03 (± 0.01)
Blooms - IM	257.01 (± 365.6)	0.47 (± 0.08)	5.41 (± 2.07)	1.7 (± 0.58)	1.85 (± 0.72)	0.18 (± 0.1)	1.07 (± 0)	0.03 (± 0.01)
Primary production regime shift - IM	257.15 (± 351.33)	0.48 (± 0.09)	3.88 (± 2.93)	2.36 (± 1.13)	1.77 (± 0.76)	0.24 (± 0.15)	1.1 (± 0.05)	0.03 (± 0.02)
Fish kills - IM	257.69 (± 357.35)	0.47 (± 0.08)	4.9 (± 0.82)	1.61 (± 0.5)	2.4 (± 1.28)	0.18 (± 0.1)	1.07 (± 0.01)	0.03 (± 0.01)
Range extensions - IM	276.61 (± 294.77)	0.58 (± 0.21)	7.13 (± 5.41)	2.29 (± 1.5)	2.98 (± 2)	0.18 (± 0.1)	1.03 (± 0.07)	0.03 (± 0.01)
Gear switching allowed - IM	237.93 (± 276.7)	0.49 (± 0.09)	0.89 (± 0.48)	1.76 (± 0.69)	2.09 (± 1.17)	0.19 (± 0.1)	1.09 (± 0)	0.03 (± 0.01)
High compliance - IM	256.9 (± 335.94)	0.48 (± 0.09)	4.13 (± 1.47)	1.86 (± 0.75)	2.93 (± 2.02)	0.18 (± 0.1)	1.07 (± 0.02)	0.03 (± 0.01)
Low Compliance - IM	176.38 (± 232.11)	0.47 (± 0.08)	6.3 (± 3.2)	1.53 (± 0.39)	2.01 (± 1.14)	0.18 (± 0.09)	1.06 (± 0.01)	0.03 (± 0.01)
Flexible fisher behaviour - IM	258.13 (± 345.59)	0.48 (± 0.08)	3.01 (± 0.46)	1.73 (± 0.56)	2.2 (± 1.02)	0.18 (± 0.1)	1.07 (± 0.01)	0.03 (± 0.01)
Increased fishing pressure drivers - IM	258.19 (± 357.15)	0.47 (± 0.08)	4.77 (± 0.42)	1.68 (± 0.69)	2.44 (± 1.39)	0.18 (± 0.1)	1.07 (± 0.01)	0.03 (± 0.01)
High Cost, Low Values - IM	20.43 (± 17.7)	0.49 (± 0.09)	0.13 (± 0.15)	1.48 (± 0.54)	2.06 (± 1.13)	0.19 (± 0.1)	1.1 (± 0)	0.03 (± 0.01)
Low Costs, High Values - IM	181.45 (± 196.06)	0.46 (± 0.11)	3.02 (± 1.36)	1.76 (± 0.62)	2.27 (± 1.42)	0.24 (± 0.05)	1.5 (± 0.72)	0.04 (± 0.01)
Standard Markets - IM	258.19 (± 357.15)	0.47 (± 0.08)	4.77 (± 0.42)	1.68 (± 0.69)	2.44 (± 1.39)	0.18 (± 0.1)	1.07 (± 0.01)	0.03 (± 0.01)
Technology Creep - IM	242.56 (± 316.39)	0.48 (± 0.09)	0.81 (± 0.56)	1.55 (± 0.53)	2.67 (± 1.84)	0.19 (± 0.1)	1.1 (± 0.01)	0.03 (± 0.01)
No Acclimation - 2010 coastal context - IM	47.87 (± 46.91)	0.19 (± 0.26)	1.45 (± 1.28)	0.87 (± 1.35)	4.13 (± 2.99)	0.09 (± 0.06)	0.18 (± 0.09)	0.01 (± 0.01)
No Acclimation - Cumulative impacts - SQ	354.03 (± 313.19)	0.18 (± 0.26)	7.01 (± 7.19)	2.27 (± 3.73)	1.62 (± 1.3)	0.02 (± 0.03)	0.19 (± 0.13)	0 (± 0)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
No Climate change - 2010 context - SQ	0.52 (± 0.39)	1.34 (± 0.04)	1.1 (± 0.13)	0.15 (± 0.07)	1.35 (± 0.21)	0.88 (± 0.03)	0.46 (± 0.08)	2.01 (± 0.11)
2010 coastal context - Cap ecosystem take	2.79 (± 1.99)	1.57 (± 0.47)	1.01 (± 0.41)	0.14 (± 0.04)	7001.95 (± 12125.28)	0.83 (± 0.22)	0.43 (± 0.26)	1.7 (± 0.71)
2010 coastal context - Centralised mgmt.	1.86 (± 0.99)	1.31 (± 0.1)	0.84 (± 0.12)	0.12 (± 0.05)	1.4 (± 0.89)	0.83 (± 0.22)	0.32 (± 0.12)	1.4 (± 0.17)
2010 coastal context - FewMPA	1.88 (± 0.92)	1.34 (± 0.1)	0.4 (± 0.07)	0.09 (± 0.04)	352.58 (± 610.68)	0.54 (± 0.14)	0.32 (± 0.12)	1.06 (± 0.14)
2010 coastal context - Fragmented mgmt	2.17 (± 1.33)	1.32 (± 0.1)	0.82 (± 0.15)	0.12 (± 0.05)	1.1 (± 0.96)	0.82 (± 0.21)	0.32 (± 0.12)	1.39 (± 0.17)
2010 coastal context - ManyMPA	1.85 (± 0.87)	1.31 (± 0.11)	0.97 (± 0.17)	0.12 (± 0.05)	8.64 (± 3.64)	0.86 (± 0.22)	0.32 (± 0.12)	1.46 (± 0.19)
2010 coastal context - Seasons	1.86 (± 1)	1.31 (± 0.11)	0.98 (± 0.17)	0.12 (± 0.05)	8.6 (± 3.54)	0.86 (± 0.22)	0.32 (± 0.12)	1.45 (± 0.19)
2010 coastal context - SlowAssess	1.96 (± 1.12)	1.27 (± 0.13)	1.49 (± 0.57)	0.12 (± 0.05)	817.74 (± 1363.45)	1.05 (± 0.42)	0.45 (± 0.24)	2.34 (± 0.9)
2010 coastal context - Integrated Mgmt (IM)	2.19 (± 1.19)	1.32 (± 0.07)	1.93 (± 0.85)	0.14 (± 0.07)	1282.52 (± 1112.31)	0.74 (± 0.11)	0.9 (± 0.38)	2.59 (± 0.88)
Cumulative impacts - 2010 Status Quo (SQ)	2.16 (± 0.33)	1.25 (± 0.07)	1 (± 0.02)	0.07 (± 0)	2.23 (± 3.74)	0.8 (± 0.01)	0.59 (± 0)	2.01 (± 0)
Cumulative impacts - Cap ecosystem take	2.95 (± 0.72)	1.49 (± 0.47)	1.25 (± 0.39)	0.08 (± 0.02)	576.7 (± 998.66)	1.08 (± 0.46)	0.78 (± 0.33)	2.45 (± 0.72)
Cumulative impacts - Centralised mgmt.	2.17 (± 0.48)	1.24 (± 0.07)	1.05 (± 0)	0.07 (± 0)	618.55 (± 1071.04)	0.82 (± 0.01)	0.59 (± 0)	2.05 (± 0.03)
Cumulative impacts - FewMPA	2.19 (± 0.21)	1.27 (± 0.07)	0.5 (± 0.02)	0.05 (± 0)	17.37 (± 30.08)	0.54 (± 0.01)	0.59 (± 0)	1.56 (± 0.04)
Cumulative impacts - Fragmented mgmt	2.38 (± 0.24)	1.25 (± 0.07)	1.03 (± 0.05)	0.07 (± 0)	54.84 (± 94.7)	0.81 (± 0.01)	0.59 (± 0)	2.04 (± 0.05)
Cumulative impacts - ManyMPA	2.22 (± 0.38)	1.24 (± 0.08)	1.21 (± 0.05)	0.07 (± 0)	772.25 (± 1335.78)	0.85 (± 0.01)	0.59 (± 0)	2.15 (± 0.04)
Cumulative impacts - Seasons	2.1 (± 0.15)	1.24 (± 0.08)	1.22 (± 0.05)	0.07 (± 0)	784.94 (± 1357.79)	0.85 (± 0.01)	0.59 (± 0)	2.13 (± 0.04)
Cumulative impacts - SlowAssess	2.82 (± 1.17)	1.3 (± 0.06)	0.7 (± 0.3)	0.07 (± 0.01)	0.09 (± 0.14)	0.85 (± 0.27)	0.45 (± 0.12)	1.45 (± 0.54)
Cumulative impacts - IM	0.85 (± 0.49)	0.93 (± 0.52)	0.87 (± 0.31)	0.08 (± 0.01)	1.42 (± 1.88)	0.54 (± 0.14)	1.1 (± 0.75)	1.67 (± 0.77)
Expanded LTL fishery - IM	2.22 (± 1.21)	1.33 (± 0.1)	0.88 (± 0.13)	0.12 (± 0.05)	2.12 (± 1.31)	0.84 (± 0.22)	0.32 (± 0.12)	1.42 (± 0.17)
New mesopelgic fishery - IM	2.26 (± 1.24)	1.32 (± 0.11)	0.89 (± 0.12)	0.12 (± 0.05)	3.67 (± 3.28)	0.85 (± 0.23)	0.32 (± 0.12)	1.43 (± 0.16)
Extreme climate events - IM	1.83 (± 1.07)	1.32 (± 0.11)	0.8 (± 0.11)	0.12 (± 0.05)	0.7 (± 0.56)	0.82 (± 0.22)	0.32 (± 0.12)	1.37 (± 0.17)
Blooms - IM	2.09 (± 1.34)	1.31 (± 0.11)	0.8 (± 0.13)	0.12 (± 0.05)	0.61 (± 0.2)	0.82 (± 0.21)	0.32 (± 0.12)	1.37 (± 0.19)
Primary production regime shift - IM	1.67 (± 0.92)	1.32 (± 0.12)	0.87 (± 0.2)	0.13 (± 0.07)	3.86 (± 5.53)	0.91 (± 0.15)	0.32 (± 0.12)	1.45 (± 0.18)
Fish kills - IM	1.78 (± 0.95)	1.31 (± 0.11)	0.8 (± 0.11)	0.12 (± 0.05)	0.78 (± 0.57)	0.82 (± 0.22)	0.32 (± 0.12)	1.37 (± 0.16)
Range extensions - IM	1.77 (± 1.01)	1.27 (± 0.18)	0.78 (± 0.19)	0.12 (± 0.05)	1.06 (± 0.68)	0.83 (± 0.22)	0.32 (± 0.13)	1.38 (± 0.18)
Gear switching allowed - IM	1.95 (± 1.29)	1.31 (± 0.1)	0.97 (± 0.16)	0.12 (± 0.05)	8.52 (± 3.52)	0.86 (± 0.22)	0.32 (± 0.12)	1.44 (± 0.19)
High compliance - IM	2.35 (± 1.57)	1.31 (± 0.1)	0.82 (± 0.12)	0.12 (± 0.05)	1.42 (± 1.24)	0.82 (± 0.22)	0.32 (± 0.12)	1.38 (± 0.13)
Low Compliance - IM	1.97 (± 1.18)	1.32 (± 0.11)	0.75 (± 0.16)	0.11 (± 0.05)	0.19 (± 0.2)	0.8 (± 0.19)	0.32 (± 0.12)	1.33 (± 0.19)
Flexible fisher behaviour - IM	1.48 (± 0.82)	1.31 (± 0.11)	0.85 (± 0.13)	0.12 (± 0.05)	1.52 (± 0.72)	0.84 (± 0.22)	0.32 (± 0.12)	1.41 (± 0.18)
Increased fishing pressure drivers - IM	1.83 (± 0.88)	1.32 (± 0.11)	0.8 (± 0.1)	0.12 (± 0.05)	0.72 (± 0.66)	0.82 (± 0.22)	0.32 (± 0.12)	1.37 (± 0.16)
High Cost, Low Values - IM	2.12 (± 1.28)	1.31 (± 0.11)	0.98 (± 0.17)	0.12 (± 0.05)	8.68 (± 3.59)	0.86 (± 0.22)	0.32 (± 0.12)	1.45 (± 0.19)

Scenario	Baleen whales	Dolphins	Orcas	Lobster	Cephalopod	Other benthic filter feeder	Deep benthic filter feeder	Macrozoobenthos
Low Costs, High Values - IM	3.76 (± 3.31)	1.82 (± 0.91)	1.23 (± 0.74)	0.15 (± 0.06)	2335.18 (± 4041.5)	1.35 (± 0.88)	0.54 (± 0.44)	2.04 (± 1.27)
Standard Markets - IM	1.83 (± 0.88)	1.32 (± 0.11)	0.8 (± 0.1)	0.12 (± 0.05)	0.72 (± 0.66)	0.82 (± 0.22)	0.32 (± 0.12)	1.37 (± 0.16)
Technology Creep - IM	2.12 (± 1.2)	1.31 (± 0.1)	0.95 (± 0.15)	0.12 (± 0.05)	6.11 (± 2.97)	0.85 (± 0.22)	0.32 (± 0.12)	1.41 (± 0.19)
No Acclimation - 2010 coastal context - IM	0.34 (± 0.25)	0.22 (± 0.11)	0.14 (± 0.08)	0.09 (± 0.03)	141.26 (± 243.76)	0.4 (± 0.15)	0.15 (± 0.07)	1.07 (± 0.17)
No Acclimation - Cumulative impacts - SQ	1.21 (± 1.04)	0.37 (± 0.2)	0.09 (± 0.07)	0.07 (± 0.02)	0.07 (± 0.08)	0.49 (± 0.07)	0.09 (± 0.07)	0.82 (± 0.19)

Scenario	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic_bacteria	Sediment_bacteria	Meiobenthos
No Climate change - 2010 context - SQ	0.29 (± 0.03)	1.23 (± 0.01)	0.85 (± 0.49)	0.8 (± 0.06)	5.16 (± 0.9)	2.89 (± 0.08)	0.69 (± 0.07)
2010 coastal context - Cap ecosystem take	1.09 (± 0.17)	7.08 (± 9.99)	0.68 (± 0.02)	0.73 (± 0.02)	1.73 (± 0.25)	5.51 (± 2.43)	2.23 (± 0.74)
2010 coastal context - Centralised mgmt.	1.28 (± 0.32)	7.18 (± 9.71)	0.69 (± 0)	0.74 (± 0)	2.11 (± 0.92)	6.01 (± 1.52)	2.34 (± 0.56)
2010 coastal context - FewMPA	1.3 (± 0.33)	7.22 (± 9.77)	0.69 (± 0)	0.75 (± 0)	2.13 (± 0.93)	6.22 (± 1.6)	2.4 (± 0.58)
2010 coastal context - Fragmented mgmt	1.28 (± 0.32)	7.27 (± 9.83)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.92)	6.03 (± 1.52)	2.34 (± 0.57)
2010 coastal context - ManyMPA	1.27 (± 0.32)	7.07 (± 9.58)	0.69 (± 0)	0.73 (± 0)	2.1 (± 0.91)	5.9 (± 1.52)	2.31 (± 0.56)
2010 coastal context - Seasons	1.27 (± 0.32)	7.08 (± 9.59)	0.69 (± 0)	0.73 (± 0)	2.1 (± 0.91)	5.91 (± 1.52)	2.31 (± 0.56)
2010 coastal context - SlowAssess	0.65 (± 0.3)	7.07 (± 9.84)	0.67 (± 0.05)	0.75 (± 0.01)	2.68 (± 0.95)	4.54 (± 2.39)	1.92 (± 0.33)
2010 coastal context - Integrated Mgmt (IM)	1.45 (± 0.72)	5.31 (± 7)	0.61 (± 0.03)	0.79 (± 0.04)	5.95 (± 2.02)	1.36 (± 0.83)	0.66 (± 0.26)
Cumulative impacts - 2010 Status Quo (SQ)	0.65 (± 0)	6.01 (± 7.8)	0.7 (± 0)	0.78 (± 0)	3.27 (± 0)	3.14 (± 0.01)	1.74 (± 0)
Cumulative impacts - Cap ecosystem take	0.57 (± 0.14)	5.8 (± 7.92)	0.69 (± 0.02)	0.76 (± 0.02)	2.87 (± 0.69)	2.75 (± 0.66)	1.62 (± 0.19)
Cumulative impacts - Centralised mgmt.	0.65 (± 0)	5.92 (± 7.66)	0.7 (± 0)	0.77 (± 0)	3.27 (± 0.01)	3.12 (± 0.02)	1.73 (± 0.01)
Cumulative impacts - FewMPA	0.66 (± 0)	5.95 (± 7.71)	0.7 (± 0)	0.78 (± 0)	3.3 (± 0)	3.22 (± 0.01)	1.78 (± 0.01)
Cumulative impacts - Fragmented mgmt	0.65 (± 0)	5.99 (± 7.76)	0.7 (± 0)	0.77 (± 0.01)	3.27 (± 0.01)	3.13 (± 0.03)	1.73 (± 0.01)
Cumulative impacts - ManyMPA	0.64 (± 0)	5.83 (± 7.56)	0.69 (± 0)	0.77 (± 0)	3.25 (± 0.01)	3.06 (± 0.02)	1.71 (± 0.01)
Cumulative impacts - Seasons	0.64 (± 0)	5.83 (± 7.57)	0.69 (± 0)	0.77 (± 0)	3.25 (± 0.01)	3.06 (± 0.01)	1.71 (± 0.01)
Cumulative impacts - SlowAssess	1.01 (± 0.54)	6.06 (± 7.57)	0.67 (± 0.05)	0.78 (± 0.01)	2.74 (± 0.91)	4.97 (± 2.13)	2.53 (± 1.17)
Cumulative impacts - IM	2.11 (± 3.17)	4.6 (± 5.33)	0.61 (± 0.02)	0.83 (± 0.05)	6.38 (± 3.19)	1.77 (± 1.46)	0.8 (± 0.26)
Expanded LTL fishery - IM	1.28 (± 0.32)	7.17 (± 9.7)	0.69 (± 0)	0.74 (± 0)	2.11 (± 0.92)	6.18 (± 1.58)	2.33 (± 0.56)
New mesopelgic fishery - IM	1.28 (± 0.32)	7.16 (± 9.7)	0.69 (± 0)	0.74 (± 0)	2.11 (± 0.92)	6.16 (± 1.57)	2.33 (± 0.56)
Extreme climate events - IM	1.28 (± 0.32)	7.3 (± 9.9)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.92)	6.06 (± 1.57)	2.35 (± 0.57)
Blooms - IM	1.28 (± 0.32)	7.33 (± 9.96)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.91)	6.06 (± 1.58)	2.35 (± 0.57)
Primary production regime shift - IM	1.14 (± 0.54)	7.14 (± 9.63)	0.67 (± 0.05)	0.75 (± 0.01)	2.14 (± 0.9)	6.25 (± 1.8)	2.5 (± 0.59)
Fish kills - IM	1.28 (± 0.32)	7.25 (± 9.82)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.92)	6.06 (± 1.54)	2.35 (± 0.56)

Scenario	Diatoms	Picophytoplankton	Copepods	Microzooplankton	Pelagic_bacteria	Sediment_bacteria	Meiobenthos
Range extensions - IM	1.28 (± 0.32)	7.24 (± 9.81)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.91)	6.08 (± 1.58)	2.35 (± 0.58)
Gear switching allowed - IM	1.27 (± 0.32)	7.07 (± 9.58)	0.69 (± 0)	0.73 (± 0)	2.1 (± 0.91)	5.91 (± 1.52)	2.31 (± 0.56)
High compliance - IM	1.28 (± 0.33)	7.17 (± 9.66)	0.69 (± 0)	0.74 (± 0.01)	2.12 (± 0.92)	6.02 (± 1.48)	2.34 (± 0.56)
Low Compliance - IM	1.28 (± 0.32)	7.33 (± 9.9)	0.7 (± 0)	0.75 (± 0)	2.12 (± 0.92)	6.11 (± 1.57)	2.37 (± 0.59)
Flexible fisher behaviour - IM	1.28 (± 0.32)	7.22 (± 9.78)	0.69 (± 0)	0.74 (± 0)	2.11 (± 0.92)	6 (± 1.54)	2.34 (± 0.57)
Increased fishing pressure drivers - IM	1.28 (± 0.32)	7.29 (± 9.88)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.92)	6.06 (± 1.55)	2.35 (± 0.56)
High Cost, Low Values - IM	1.27 (± 0.32)	7.07 (± 9.57)	0.69 (± 0)	0.73 (± 0)	2.1 (± 0.91)	5.91 (± 1.52)	2.31 (± 0.56)
Low Costs, High Values - IM	0.89 (± 0.42)	6.88 (± 10.1)	0.67 (± 0.04)	0.71 (± 0.04)	1.34 (± 0.43)	4.96 (± 3.33)	2.11 (± 0.92)
Standard Markets - IM	1.28 (± 0.32)	7.29 (± 9.88)	0.69 (± 0)	0.74 (± 0)	2.12 (± 0.92)	6.06 (± 1.55)	2.35 (± 0.56)
Technology Creep - IM	1.27 (± 0.32)	7.13 (± 9.66)	0.69 (± 0)	0.73 (± 0)	2.11 (± 0.91)	5.93 (± 1.53)	2.32 (± 0.56)
No Acclimation - 2010 coastal context - IM	0.38 (± 0.34)	4.02 (± 4.04)	0.59 (± 0.24)	0.83 (± 0.13)	6.77 (± 6.17)	19.62 (± 28.1)	1.02 (± 0.23)
No Acclimation - Cumulative impacts - SQ	1.41 (± 1.59)	5.25 (± 5.88)	0.68 (± 0.3)	0.8 (± 0.11)	3.33 (± 2.75)	89.9 (± 137.92)	3.49 (± 2.25)

Scenario	Labile detritus	Refractory detritus
No Climate change - 2010 context - SQ	17.09 (± 3.09)	11.95 (± 1.38)
2010 coastal context - Cap ecosystem take	1.73 (± 1.12)	1.4 (± 0.09)
2010 coastal context - Centralised mgmt.	2.3 (± 2.12)	1.68 (± 0.55)
2010 coastal context - FewMPA	2.37 (± 2.18)	1.7 (± 0.55)
2010 coastal context - Fragmented mgmt	2.31 (± 2.13)	1.68 (± 0.55)
2010 coastal context - ManyMPA	2.26 (± 2.07)	1.65 (± 0.54)
2010 coastal context - Seasons	2.26 (± 2.07)	1.65 (± 0.54)
2010 coastal context - SlowAssess	9.98 (± 7.63)	7.7 (± 5.59)
2010 coastal context - Integrated Mgmt (IM)	83.85 (± 124.21)	32.82 (± 37.87)
Cumulative impacts - 2010 Status Quo (SQ)	14.42 (± 0.04)	10.63 (± 0.04)
Cumulative impacts - Cap ecosystem take	12.6 (± 3.01)	9.3 (± 2.24)
Cumulative impacts - Centralised mgmt.	14.3 (± 0.08)	10.54 (± 0.08)
Cumulative impacts - FewMPA	14.74 (± 0.03)	10.7 (± 0.08)
Cumulative impacts - Fragmented mgmt	14.35 (± 0.15)	10.58 (± 0.14)
Cumulative impacts - ManyMPA	14.04 (± 0.07)	10.37 (± 0.08)
Cumulative impacts - Seasons	14.04 (± 0.07)	10.37 (± 0.08)
Cumulative impacts - SlowAssess	6.77 (± 6.75)	4.89 (± 4.85)

Scenario	Labile detritus	Refractory detritus
Cumulative impacts - IM	65.75 (± 96.48)	32.56 (± 44.16)
Expanded LTL fishery - IM	2.35 (± 2.16)	1.69 (± 0.56)
New mesopelgic fishery - IM	2.35 (± 2.17)	1.69 (± 0.56)
Extreme climate events - IM	2.32 (± 2.13)	1.69 (± 0.55)
Blooms - IM	2.31 (± 2.11)	1.69 (± 0.54)
Primary production regime shift - IM	2.34 (± 2.11)	1.75 (± 0.49)
Fish kills - IM	2.32 (± 2.14)	1.69 (± 0.56)
Range extensions - IM	2.31 (± 2.11)	1.69 (± 0.54)
Gear switching allowed - IM	2.26 (± 2.07)	1.65 (± 0.53)
High compliance - IM	2.32 (± 2.16)	1.69 (± 0.57)
Low Compliance - IM	2.33 (± 2.13)	1.7 (± 0.55)
Flexible fisher behaviour - IM	2.29 (± 2.11)	1.67 (± 0.55)
Increased fishing pressure drivers - IM	2.32 (± 2.14)	1.69 (± 0.56)
High Cost, Low Values - IM	2.25 (± 2.07)	1.65 (± 0.53)
Low Costs, High Values - IM	1.14 (± 0.14)	1.11 (± 0.44)
Standard Markets - IM	2.32 (± 2.14)	1.69 (± 0.56)
Technology Creep - IM	2.27 (± 2.08)	1.65 (± 0.54)
No Acclimation - 2010 coastal context - IM	162.79 (± 274.79)	20.48 (± 25.7)
No Acclimation - Cumulative impacts - SQ	231.91 (± 401.22)	14.94 (± 24.44)

Table A. 10: Mean relative landings (± s.e.) 2065-2070 of each fished group in Atlantis-SEAP for each strategy-scenario combination under RCP 3. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics and new fisheries “Active fishery” or “Major fishery” is noted as there is no fishery initially.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.47 (± 0.39)	1.15 (± 0.41)	44.39 (± 1.04)	4.94 (± 3.53)	20.81 (± 25.87)	1.36 (± 1.17)	4.1 (± 4.05)	0.39 (± 0.26)
2010 coastal context - Cap ecosystem take	0.84 (± 0.9)	0.47 (± 0.3)	4.25 (± 5.8)	2.58 (± 1.12)	195.18 (± 265.14)	3.95 (± 6.27)	3.07 (± 0.74)	0.13 (± 0.08)
2010 coastal context - Centralised mgmt.	0.84 (± 0.91)	0.51 (± 0.51)	4.25 (± 5.83)	2.57 (± 1.14)	190.85 (± 256.57)	0.33 (± 0.29)	23.46 (± 35.34)	0.13 (± 0.08)
2010 coastal context - FewMPA	0.85 (± 0.92)	0.66 (± 1.09)	2.48 (± 3.43)	2.74 (± 1.34)	105.85 (± 86.78)	12.63 (± 20.84)	15.19 (± 4.84)	0.14 (± 0.1)
2010 coastal context - Fragmented mgmt	0.84 (± 0.9)	0.67 (± 0.73)	4.24 (± 5.82)	2.59 (± 1.16)	251.34 (± 380.42)	2.91 (± 4.69)	3.63 (± 0.48)	0.13 (± 0.08)
2010 coastal context - ManyMPA	0.82 (± 0.87)	2.55 (± 3.34)	3.34 (± 4.6)	2.28 (± 1.05)	220.56 (± 202.64)	10.31 (± 16.94)	0.22 (± 0.37)	0.12 (± 0.08)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
2010 coastal context - Seasons	0.56 (± 0.61)	0.67 (± 1)	3.01 (± 4.34)	0.02 (± 0.01)	38.97 (± 43.25)	18.83 (± 30.77)	13.72 (± 1.86)	0 (± 0)
2010 coastal context - SlowAssess	0.67 (± 1.04)	0.23 (± 0.21)	4.69 (± 6.56)	1.34 (± 0.66)	46.09 (± 43.95)	137.92 (± 206.39)	2.84 (± 0.97)	0.07 (± 0.01)
2010 coastal context - Integrated Mgmt (IM)	0.67 (± 1.04)	0.46 (± 0.26)	4.65 (± 6.49)	1.35 (± 0.67)	97.97 (± 132.88)	158.27 (± 143.19)	2.84 (± 1.13)	0.07 (± 0.01)
Cumulative impacts - 2010 Status Quo (SQ)	0.38 (± 0.55)	0.26 (± 0.36)	4.33 (± 6.05)	1.13 (± 0.66)	24.19 (± 28.66)	21.72 (± 19.96)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - Cap ecosystem take	0.38 (± 0.55)	0.17 (± 0.15)	4.33 (± 6.03)	1.12 (± 0.64)	34.12 (± 38.56)	13.77 (± 10.07)	0 (± 0)	0.06 (± 0.02)
Cumulative impacts - Centralised mgmt.	0.38 (± 0.55)	0.2 (± 0.25)	4.33 (± 6.06)	1.12 (± 0.65)	34.38 (± 37.05)	8.15 (± 7.47)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - FewMPA	0.39 (± 0.55)	0.29 (± 0.5)	2.52 (± 3.57)	1.2 (± 0.75)	20.01 (± 12.12)	37 (± 37.92)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - Fragmented mgmt	0.38 (± 0.55)	0.27 (± 0.35)	4.32 (± 6.06)	1.13 (± 0.66)	41.3 (± 57.09)	9.44 (± 7.76)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - ManyMPA	0.37 (± 0.53)	1.08 (± 1.56)	3.4 (± 4.78)	1 (± 0.59)	45.23 (± 32.08)	30.79 (± 30.37)	0 (± 0)	0.05 (± 0.02)
Cumulative impacts - Seasons	0.26 (± 0.37)	0.29 (± 0.46)	3.07 (± 4.5)	0.01 (± 0.01)	7.55 (± 6.28)	57.39 (± 53.72)	0 (± 0)	0 (± 0)
Cumulative impacts - SlowAssess	0.56 (± 0.42)	0.1 (± 0.13)	3.99 (± 5.45)	2.37 (± 1.5)	71.56 (± 74.6)	3.98 (± 6.28)	0 (± 0)	0.12 (± 0.1)
Cumulative impacts - IM	0.56 (± 0.42)	0.18 (± 0.17)	3.95 (± 5.39)	2.34 (± 1.45)	93.96 (± 79.37)	19.63 (± 33.49)	0 (± 0)	0.12 (± 0.1)
Expanded LTL fishery - IM	0.84 (± 0.9)	0.52 (± 0.56)	4.17 (± 5.73)	2.62 (± 1.2)	181.57 (± 220.27)	0.09 (± 0.15)	9.57 (± 7.28)	0.14 (± 0.09)
New mesopelgic fishery - IM	0.91 (± 0.98)	0.34 (± 0.52)	10.17 (± 14.47)	0.03 (± 0.01)	379.43 (± 552.59)	1.29 (± 2.18)	4.6 (± 2.21)	0 (± 0)
Extreme climate events - IM	0.92 (± 0.98)	0.21 (± 0.3)	9.88 (± 13.96)	0.03 (± 0.01)	390.94 (± 569.56)	2.27 (± 3.45)	1.04 (± 0.45)	0 (± 0)
Blooms - IM	0.91 (± 0.97)	0.16 (± 0.24)	9.92 (± 14.07)	0.03 (± 0.01)	396.59 (± 573.8)	7.52 (± 12.19)	0.96 (± 1.42)	0 (± 0)
Primary production regime shift - IM	0.94 (± 1.03)	0.24 (± 0.19)	9.84 (± 13.95)	0.03 (± 0.01)	392.53 (± 569.02)	3.39 (± 5.41)	8.7 (± 9.75)	0 (± 0)
Fish kills - IM	0.91 (± 0.98)	0.1 (± 0.11)	9.89 (± 13.99)	0.03 (± 0.01)	373.78 (± 549.22)	3.73 (± 6.24)	1.56 (± 1.07)	0 (± 0)
Range extensions - IM	0.84 (± 0.9)	0.59 (± 0.6)	4.26 (± 5.8)	2.6 (± 1.16)	78.78 (± 68.18)	4.59 (± 7.52)	6.1 (± 3.53)	0.13 (± 0.08)
Gear switching allowed - IM	0.84 (± 0.9)	0.82 (± 1.12)	2.47 (± 3.4)	2.72 (± 1.32)	76 (± 31.98)	11.6 (± 19.64)	7.41 (± 2.5)	0.14 (± 0.09)
High compliance - IM	0.84 (± 0.91)	0.51 (± 0.36)	4.19 (± 5.74)	2.59 (± 1.12)	126.3 (± 114.2)	0.29 (± 0.26)	1.52 (± 0.27)	0.13 (± 0.08)
Low Compliance - IM	0.84 (± 0.9)	0.85 (± 1.25)	4.4 (± 6.01)	2.61 (± 1.22)	83.69 (± 38.57)	7.55 (± 12.39)	1.78 (± 1.67)	0.14 (± 0.09)
Flexible fisher behaviour - IM	2.33 (± 2.5)	0.51 (± 0.32)	11.08 (± 15.13)	7.24 (± 3.3)	162.16 (± 190.51)	0.14 (± 0.25)	4.91 (± 1.56)	0.37 (± 0.24)
Increased fishing pressure drivers - IM	0.84 (± 0.9)	0.47 (± 0.3)	4.25 (± 5.8)	2.58 (± 1.12)	195.18 (± 265.14)	7.27 (± 11.96)	3.07 (± 0.74)	0.13 (± 0.08)
High Cost, Low Values - IM	0.85 (± 0.92)	0.41 (± 0.52)	2.46 (± 3.41)	2.73 (± 1.31)	141.89 (± 89.87)	12.36 (± 20.35)	3.12 (± 0.73)	0.14 (± 0.09)
Low Costs, High Values - IM	0.84 (± 0.9)	0.52 (± 0.33)	4.24 (± 5.82)	2.59 (± 1.15)	246.13 (± 369.26)	1.19 (± 2.01)	5.67 (± 2.81)	0.13 (± 0.08)
Standard Markets - IM	0.84 (± 0.91)	0.61 (± 0.77)	4.25 (± 5.82)	2.59 (± 1.16)	140.37 (± 195.77)	7.04 (± 11.48)	3.52 (± 1.92)	0.13 (± 0.08)
Technology Creep - IM	1.61 (± 1.73)	0.77 (± 1.07)	7.06 (± 9.63)	5.21 (± 2.45)	190.68 (± 118.17)	4.73 (± 8.17)	7.95 (± 5.88)	0.27 (± 0.18)
No Acclimation - 2010 coastal context - IM	0 (± 0)	2.04 (± 1.29)	0.05 (± 0.06)	0.11 (± 0.05)	0 (± 0)	0.42 (± 0.46)	0 (± 0)	0.01 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	1.54 (± 1.42)	0.04 (± 0.06)	0.11 (± 0.05)	0 (± 0)	0.78 (± 1.31)	0 (± 0)	0.01 (± 0)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.96 (± 0.85)	0 (± 0)	0 (± 0)	9.71 (± 10.99)	15.51 (± 4.44)	28.86 (± 25.33)	20.33 (± 16.28)	2.87 (± 1.91)
2010 coastal context - Cap ecosystem take	0.24 (± 0.03)	0 (± 0)	0 (± 0)	7.38 (± 4.5)	61.45 (± 58.35)	26.76 (± 28.71)	16.59 (± 20.52)	6.97 (± 3.99)
2010 coastal context - Centralised mgmt.	0.15 (± 0.07)	0 (± 0)	0 (± 0)	3.85 (± 2.13)	53.05 (± 36.78)	37.34 (± 35.53)	12.32 (± 13.66)	4.01 (± 3.32)
2010 coastal context - FewMPA	0.14 (± 0.14)	0 (± 0)	0 (± 0)	3.17 (± 2.55)	72.52 (± 52.19)	51.45 (± 23.75)	16.01 (± 15.3)	2.58 (± 1.95)
2010 coastal context - Fragmented mgmt	0.42 (± 0.44)	0 (± 0)	0 (± 0)	44.67 (± 65.54)	64.48 (± 37.16)	19.39 (± 14.35)	12.31 (± 14.23)	4.52 (± 3.64)
2010 coastal context - ManyMPA	0.66 (± 0.2)	0 (± 0)	0 (± 0)	18.46 (± 9.38)	17.98 (± 27.62)	0.26 (± 0.26)	14.73 (± 12.63)	6.98 (± 4.23)
2010 coastal context - Seasons	0.28 (± 0.3)	0 (± 0)	0 (± 0)	6.04 (± 4.47)	77.01 (± 34.76)	50.19 (± 19.01)	17.43 (± 17.33)	4.95 (± 3.34)
2010 coastal context - SlowAssess	0.53 (± 0.74)	0 (± 0)	0 (± 0)	42.54 (± 68.16)	43.15 (± 46.49)	24.89 (± 24.62)	9.67 (± 7.17)	6.59 (± 7.14)
2010 coastal context - Integrated Mgmt (IM)	0.39 (± 0.34)	0 (± 0)	0 (± 0)	4.64 (± 2.55)	65.94 (± 24.39)	18.35 (± 13.24)	14.06 (± 11.07)	5.51 (± 4.37)
Cumulative impacts - 2010 Status Quo (SQ)	0.16 (± 0.13)	0 (± 0)	0 (± 0)	24.6 (± 40.68)	30.19 (± 21.06)	0 (± 0)	9.01 (± 8.2)	2.91 (± 4.81)
Cumulative impacts - Cap ecosystem take	0.41 (± 0.45)	0 (± 0)	0 (± 0)	1.75 (± 0.19)	32.67 (± 33.29)	0 (± 0)	9.89 (± 9.29)	3.33 (± 5.41)
Cumulative impacts - Centralised mgmt.	0.27 (± 0.29)	0 (± 0)	0 (± 0)	1.08 (± 0.54)	24.92 (± 17.46)	0 (± 0)	7.89 (± 6.91)	2.9 (± 4.84)
Cumulative impacts - FewMPA	0.3 (± 0.49)	0 (± 0)	0 (± 0)	1.07 (± 1.12)	45.7 (± 21.49)	0 (± 0)	14.93 (± 13.56)	3.44 (± 5.86)
Cumulative impacts - Fragmented mgmt	0.96 (± 1.52)	0 (± 0)	0 (± 0)	24.65 (± 40.63)	42.89 (± 38.8)	0 (± 0)	8.69 (± 7.82)	2.92 (± 4.81)
Cumulative impacts - ManyMPA	0.31 (± 0.17)	0 (± 0)	0 (± 0)	4.85 (± 1.71)	6.64 (± 11.14)	0 (± 0)	11.53 (± 10.02)	4.27 (± 6.59)
Cumulative impacts - Seasons	0.09 (± 0.08)	0 (± 0)	0 (± 0)	2.16 (± 2.4)	46.8 (± 63.89)	0 (± 0)	11.93 (± 10.24)	2.38 (± 3.96)
Cumulative impacts - SlowAssess	0.47 (± 0.65)	0 (± 0)	0 (± 0)	1.57 (± 0.65)	25.35 (± 20.25)	0 (± 0)	11.77 (± 17.79)	1.05 (± 0.86)
Cumulative impacts - IM	0.18 (± 0.07)	0 (± 0)	0 (± 0)	3 (± 1.64)	26.09 (± 28.54)	0 (± 0)	13.59 (± 19.77)	2.05 (± 1.83)
Expanded LTL fishery - IM	0.49 (± 0.7)	0 (± 0)	0 (± 0)	2.67 (± 0.88)	115.2 (± 69.12)	50.96 (± 33.33)	16.54 (± 16.74)	2.64 (± 1.49)
New mesopelgic fishery - IM	0.21 (± 0.14)	Major fishery	Active fishery	5.03 (± 3.7)	57.51 (± 44.56)	37.83 (± 32.37)	15.64 (± 16.57)	5.36 (± 5.25)
Extreme climate events - IM	0.33 (± 0.19)	0 (± 0)	0 (± 0)	8.15 (± 3)	29.14 (± 13.36)	2.87 (± 2.36)	14.74 (± 19.72)	8.23 (± 5.38)
Blooms - IM	0.32 (± 0.16)	0 (± 0)	0 (± 0)	8.26 (± 3.53)	32.87 (± 8.4)	2.61 (± 3.55)	13.99 (± 18.46)	8.43 (± 6)
Primary production regime shift - IM	0.29 (± 0.19)	0 (± 0)	0 (± 0)	6.72 (± 0.62)	37.45 (± 17.61)	16.44 (± 13.7)	14.86 (± 18.96)	6.45 (± 2.39)
Fish kills - IM	0.37 (± 0.21)	0 (± 0)	0 (± 0)	9.19 (± 4.47)	35.86 (± 22.28)	2.95 (± 1.92)	15.58 (± 23.35)	4.11 (± 2.05)
Range extensions - IM	0.19 (± 0.01)	0 (± 0)	0 (± 0)	5.55 (± 2.7)	134.46 (± 101.65)	40.27 (± 30.55)	15.05 (± 17.16)	5.4 (± 3.13)
Gear switching allowed - IM	0.54 (± 0.71)	0 (± 0)	0 (± 0)	9.35 (± 7.41)	92.54 (± 49.31)	39.49 (± 21.29)	18.64 (± 14.09)	3.59 (± 3.41)
High compliance - IM	0.15 (± 0.09)	0 (± 0)	0 (± 0)	3.82 (± 1.75)	59.06 (± 12.58)	45.6 (± 38.77)	11.92 (± 14.26)	3.91 (± 2.89)
Low Compliance - IM	0.55 (± 0.78)	0 (± 0)	0 (± 0)	8.96 (± 8.87)	115.45 (± 86.7)	12.6 (± 14.54)	10.48 (± 12.19)	2.6 (± 2.15)
Flexible fisher behaviour - IM	0.17 (± 0.1)	0 (± 0)	0 (± 0)	4.43 (± 2.9)	111.56 (± 66.07)	50.68 (± 21.34)	14.58 (± 14.56)	4.69 (± 4.32)
Increased fishing pressure drivers - IM	0.24 (± 0.03)	0 (± 0)	0 (± 0)	7.38 (± 4.5)	139.44 (± 98.02)	26.76 (± 28.71)	16.59 (± 20.52)	6.97 (± 3.99)
High Cost, Low Values - IM	0.61 (± 0.92)	0 (± 0)	0 (± 0)	28.54 (± 43.35)	86.47 (± 76.5)	71.2 (± 6.94)	20.59 (± 18.95)	2.36 (± 1.84)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Low Costs, High Values - IM	1.15 (± 0.89)	0 (± 0)	0 (± 0)	28.27 (± 27.08)	116.85 (± 65.48)	20.87 (± 12.71)	15.54 (± 20.13)	14.46 (± 9.11)
Standard Markets - IM	0.41 (± 0.44)	0 (± 0)	0 (± 0)	44.31 (± 65.82)	109.98 (± 71.18)	30.82 (± 29.81)	13.65 (± 15.78)	4.27 (± 3.12)
Technology Creep - IM	0.21 (± 0.05)	0 (± 0)	0 (± 0)	6.22 (± 3.87)	105.1 (± 70.56)	42.86 (± 20.16)	17.8 (± 14.25)	5.72 (± 3.03)
No Acclimation - 2010 coastal context - IM	0.84 (± 0.11)	0 (± 0)	0 (± 0)	26.06 (± 15.9)	95.98 (± 48.12)	0 (± 0)	9.2 (± 13.29)	8.78 (± 5.56)
No Acclimation - Cumulative impacts - SQ	0.47 (± 0.22)	0 (± 0)	0 (± 0)	16.16 (± 14.01)	64.53 (± 20.96)	0 (± 0)	7.85 (± 12.1)	7.37 (± 7.99)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	0 (± 0)	21288.64 (± 26347.33)	2.7 (± 1.91)	1.28 (± 0.88)	1.24 (± 1.86)	36.88 (± 0.28)	1.5 (± 0.02)	0.39 (± 0.01)
2010 coastal context - Cap ecosystem take	0 (± 0)	88.06 (± 39.16)	5.67 (± 4.22)	1.35 (± 0.94)	1.08 (± 0.12)	12.52 (± 5.36)	0.28 (± 0.1)	0.53 (± 0.32)
2010 coastal context - Centralised mgmt.	0 (± 0)	327.63 (± 476.07)	4.46 (± 4.32)	1.47 (± 1.11)	1.09 (± 0.14)	12.48 (± 5.46)	0.32 (± 0.22)	0.39 (± 0.2)
2010 coastal context - FewMPA	0 (± 0)	151.19 (± 240.73)	2.52 (± 3.21)	1.79 (± 1.51)	0.62 (± 0.12)	13.3 (± 6.35)	0.14 (± 0.17)	0.73 (± 0.81)
2010 coastal context - Fragmented mgmt	0 (± 0)	176.91 (± 227.65)	2.87 (± 1.91)	1.43 (± 0.92)	1.1 (± 0.12)	12.57 (± 5.58)	0.3 (± 0.18)	0.42 (± 0.22)
2010 coastal context - ManyMPA	0 (± 0)	248.99 (± 152.93)	9.35 (± 10.84)	1.22 (± 1.06)	1.15 (± 0.16)	11.08 (± 5.01)	0.1 (± 0.11)	0.68 (± 0.64)
2010 coastal context - Seasons	0 (± 0)	132.28 (± 188.97)	1.82 (± 0.8)	1.84 (± 1.72)	1.8 (± 2.6)	0.09 (± 0.04)	0.18 (± 0.2)	1.23 (± 1.15)
2010 coastal context - SlowAssess	0 (± 0)	303.55 (± 457.37)	2.98 (± 2.79)	2.12 (± 1.73)	1.29 (± 0.9)	7.8 (± 1.29)	0.06 (± 0.06)	0.08 (± 0.14)
2010 coastal context - Integrated Mgmt (IM)	0 (± 0)	185.26 (± 200.61)	5.1 (± 4.69)	1.97 (± 1.58)	1.25 (± 0.84)	7.77 (± 1.2)	0.09 (± 0.13)	0.28 (± 0.47)
Cumulative impacts - 2010 Status Quo (SQ)	0 (± 0)	168.58 (± 278.8)	0.69 (± 0.81)	0.95 (± 1.32)	1.79 (± 1.16)	6.65 (± 2.72)	0.01 (± 0.01)	0 (± 0)
Cumulative impacts - Cap ecosystem take	0 (± 0)	95.98 (± 145.82)	0.93 (± 1.01)	1.07 (± 1.47)	1.73 (± 1.1)	6.63 (± 2.61)	0.01 (± 0.01)	0 (± 0)
Cumulative impacts - Centralised mgmt.	0 (± 0)	38.96 (± 56.78)	1.16 (± 1.69)	0.97 (± 1.46)	1.75 (± 1.12)	6.6 (± 2.66)	0.01 (± 0.01)	0 (± 0)
Cumulative impacts - FewMPA	0 (± 0)	199.13 (± 339.44)	1.12 (± 1.78)	1.42 (± 1.55)	0.97 (± 0.64)	7.03 (± 3.09)	0 (± 0.01)	0 (± 0)
Cumulative impacts - Fragmented mgmt	0 (± 0)	168.95 (± 278.49)	0.64 (± 0.7)	1.03 (± 1.26)	1.76 (± 1.12)	6.65 (± 2.72)	0.01 (± 0.01)	0 (± 0)
Cumulative impacts - ManyMPA	0 (± 0)	247.55 (± 382.04)	0.99 (± 0.36)	0.87 (± 1.4)	1.86 (± 1.2)	5.86 (± 2.44)	0 (± 0)	0 (± 0)
Cumulative impacts - Seasons	0 (± 0)	138.18 (± 229.64)	0.44 (± 0.49)	1.81 (± 1.73)	0.56 (± 0.4)	0.05 (± 0.02)	0.01 (± 0.01)	0 (± 0)
Cumulative impacts - SlowAssess	0 (± 0)	202.47 (± 338.56)	1.05 (± 1.38)	0.96 (± 1.18)	1.58 (± 0.91)	11.54 (± 7.39)	0.15 (± 0.24)	0.15 (± 0.26)
Cumulative impacts - IM	0 (± 0)	176.55 (± 281.99)	1.57 (± 1.83)	0.91 (± 0.91)	1.55 (± 0.75)	11.37 (± 7.14)	0.1 (± 0.16)	0.14 (± 0.23)
Expanded LTL fishery - IM	0 (± 0)	228.1 (± 340.81)	2.71 (± 2.24)	1.21 (± 1.03)	1.14 (± 0.17)	12.75 (± 5.75)	0.33 (± 0.26)	0.36 (± 0.22)
New mesopelgic fishery - IM	0 (± 0)	220.66 (± 262.65)	6.63 (± 6.4)	2.99 (± 0.86)	0.89 (± 0.12)	0.15 (± 0.07)	0.07 (± 0.04)	0.62 (± 0.43)
Extreme climate events - IM	0 (± 0)	252.19 (± 274.1)	6.23 (± 9.02)	2.62 (± 0.22)	0.89 (± 0.15)	0.15 (± 0.06)	0.06 (± 0.05)	0.72 (± 0.5)
Blooms - IM	0 (± 0)	149.31 (± 111.21)	6.83 (± 9.43)	2.12 (± 0.9)	0.84 (± 0.09)	0.15 (± 0.07)	0.05 (± 0.05)	0.47 (± 0.39)
Primary production regime shift - IM	0 (± 0)	199.12 (± 231.13)	4.54 (± 5.29)	2.06 (± 0.98)	0.86 (± 0.1)	0.15 (± 0.07)	0.07 (± 0.03)	0.61 (± 0.23)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
Fish kills - IM	0 (± 0)	308.87 (± 339.11)	7.72 (± 11.12)	2.18 (± 0.89)	0.84 (± 0.17)	0.15 (± 0.07)	0.06 (± 0.05)	0.51 (± 0.26)
Range extensions - IM	0 (± 0)	347.48 (± 492.33)	4.62 (± 4.23)	1.66 (± 0.99)	1.06 (± 0.21)	12.67 (± 5.62)	0.26 (± 0.21)	0.39 (± 0.29)
Gear switching allowed - IM	0 (± 0)	56.13 (± 36.11)	3.88 (± 3.76)	1.17 (± 1.4)	0.65 (± 0.21)	13.2 (± 6.28)	0.81 (± 0.93)	0.42 (± 0.42)
High compliance - IM	0 (± 0)	400.82 (± 609.28)	4.56 (± 3.99)	1.42 (± 1.04)	1.11 (± 0.15)	12.58 (± 5.38)	0.34 (± 0.11)	0.56 (± 0.4)
Low Compliance - IM	0 (± 0)	45.79 (± 27.8)	2.86 (± 2.07)	1.98 (± 1.46)	1.16 (± 0.15)	12.67 (± 5.83)	0.53 (± 0.59)	0.67 (± 0.6)
Flexible fisher behaviour - IM	0 (± 0)	410.53 (± 601.53)	4.58 (± 5.77)	1.58 (± 1.11)	2.3 (± 0.27)	31.43 (± 10.15)	0.32 (± 0.11)	0.53 (± 0.42)
Increased fishing pressure drivers - IM	0 (± 0)	419.42 (± 594.83)	4.71 (± 4.76)	1.34 (± 0.94)	1.09 (± 0.13)	12.52 (± 5.36)	0.28 (± 0.1)	0.53 (± 0.32)
High Cost, Low Values - IM	14.22 (± 5.04)	111.06 (± 152.53)	1.54 (± 0.87)	1.99 (± 1.71)	0.63 (± 0.13)	13.27 (± 6.22)	0.42 (± 0.49)	0.72 (± 0.69)
Low Costs, High Values - IM	10.47 (± 11.48)	563.09 (± 475.4)	4.26 (± 3.89)	1.21 (± 1.02)	1.09 (± 0.13)	12.61 (± 5.52)	0.35 (± 0.21)	0.57 (± 0.44)
Standard Markets - IM	0 (± 0)	176.6 (± 228.13)	2.92 (± 2.18)	1.65 (± 1.22)	1.11 (± 0.17)	12.58 (± 5.58)	0.3 (± 0.18)	0.36 (± 0.17)
Technology Creep - IM	9.05 (± 4.9)	99.54 (± 75.91)	3.73 (± 2.95)	1.74 (± 1.46)	1.72 (± 0.37)	25.3 (± 11.66)	0.62 (± 0.72)	0.56 (± 0.55)
No Acclimation - 2010 coastal context - IM	0 (± 0)	310.11 (± 137.63)	5.18 (± 3)	0 (± 0)	0.07 (± 0.1)	0.54 (± 0.23)	2.43 (± 0.88)	0.78 (± 0.47)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	244.81 (± 155.62)	4.3 (± 2.22)	0 (± 0)	0.07 (± 0.1)	0.54 (± 0.24)	2.26 (± 1.02)	0.46 (± 0.14)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
No Climate change - 2010 context - SQ	3.17 (± 2.16)	1.36 (± 1.02)	0.45 (± 0.59)	7.02 (± 0.14)	13.81 (± 8.21)	0.04 (± 0.01)	0.63 (± 0.22)	1.29 (± 0.81)
2010 coastal context - Cap ecosystem take	18.32 (± 12.01)	1.67 (± 1.15)	0.35 (± 0.2)	14.32 (± 24.48)	3.13 (± 1.73)	0 (± 0)	0.57 (± 0.11)	0.67 (± 0.56)
2010 coastal context - Centralised mgmt.	17.67 (± 8.11)	1.67 (± 1.14)	0.29 (± 0.14)	15 (± 25.64)	3.15 (± 1.74)	0 (± 0)	0.57 (± 0.15)	0.83 (± 1.18)
2010 coastal context - FewMPA	38.91 (± 50.17)	2.12 (± 1.46)	0.06 (± 0.09)	10.04 (± 17.23)	2.57 (± 1.42)	0 (± 0)	0.33 (± 0.11)	5.94 (± 9.05)
2010 coastal context - Fragmented mgmt	14.56 (± 8.63)	1.67 (± 1.15)	0.34 (± 0.1)	13 (± 22.19)	3.14 (± 1.72)	0 (± 0)	0.57 (± 0.12)	8.8 (± 9.26)
2010 coastal context - ManyMPA	46.59 (± 78.61)	1.89 (± 1.32)	0.22 (± 0.28)	0.05 (± 0.09)	6.38 (± 3.7)	0.01 (± 0)	0.22 (± 0.02)	8.16 (± 8.72)
2010 coastal context - Seasons	5.76 (± 3.7)	8.22 (± 5.67)	0.04 (± 0.03)	19.28 (± 33.01)	2.61 (± 1.43)	0 (± 0)	0.42 (± 0.09)	10.12 (± 12.52)
2010 coastal context - SlowAssess	5.09 (± 0.81)	9.45 (± 7.82)	0.16 (± 0.22)	16.05 (± 23.63)	14.28 (± 18.96)	0 (± 0)	0.58 (± 0.15)	9.77 (± 8.49)
2010 coastal context - Integrated Mgmt (IM)	0.91 (± 1.39)	7.45 (± 6.18)	0.21 (± 0.3)	15.73 (± 23.34)	13.17 (± 17.07)	0 (± 0)	0.57 (± 0.11)	8.05 (± 11.92)
Cumulative impacts - 2010 Status Quo (SQ)	2.57 (± 1.25)	7.77 (± 5.27)	0.04 (± 0.02)	15.12 (± 24.42)	17.22 (± 12.77)	0 (± 0)	0.48 (± 0.12)	1.76 (± 1.63)
Cumulative impacts - Cap ecosystem take	1.71 (± 0.78)	7.78 (± 5.28)	0.05 (± 0.05)	19.76 (± 32.5)	17.07 (± 12.64)	0 (± 0)	0.49 (± 0.11)	2.7 (± 2.49)
Cumulative impacts - Centralised mgmt.	1.35 (± 0.41)	7.76 (± 5.24)	0.04 (± 0.03)	22.87 (± 37.75)	17.15 (± 12.7)	0 (± 0)	0.49 (± 0.15)	6.09 (± 7.4)
Cumulative impacts - FewMPA	1.98 (± 1.45)	9.85 (± 6.69)	0.01 (± 0.01)	22.97 (± 38.92)	13.41 (± 9.66)	0 (± 0)	0.28 (± 0.1)	20.13 (± 32.06)
Cumulative impacts - Fragmented mgmt	3.82 (± 4.77)	7.78 (± 5.27)	0.05 (± 0.02)	13.76 (± 22.08)	17.08 (± 12.61)	0 (± 0)	0.49 (± 0.12)	11.29 (± 9.62)
Cumulative impacts - ManyMPA	1.8 (± 2.92)	8.78 (± 6.05)	0.01 (± 0.01)	0.24 (± 0.41)	21.71 (± 13.81)	0 (± 0)	0.19 (± 0.02)	10.45 (± 11.42)
Cumulative impacts - Seasons	0.87 (± 0.77)	38.21 (± 26.05)	0 (± 0)	19.6 (± 31.88)	13.63 (± 9.81)	0 (± 0)	0.36 (± 0.09)	4.23 (± 4.77)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
Cumulative impacts - SlowAssess	35.79 (± 47.1)	2.63 (± 0.51)	0.11 (± 0.12)	20.19 (± 34.82)	12.92 (± 10.47)	0.01 (± 0.01)	0.5 (± 0.15)	5.24 (± 7.49)
Cumulative impacts - IM	3.39 (± 1.25)	2.1 (± 0.35)	0.09 (± 0.13)	19.15 (± 33.02)	8.82 (± 10.73)	0 (± 0)	0.49 (± 0.11)	3.56 (± 1.9)
Expanded LTL fishery - IM	13.87 (± 6.93)	1.66 (± 1.14)	0.22 (± 0.12)	15.64 (± 26.75)	3.14 (± 1.73)	0 (± 0)	0.58 (± 0.14)	4.04 (± 3.9)
New mesopelgic fishery - IM	19.59 (± 7.87)	2.07 (± 1.4)	1.03 (± 0.06)	19.16 (± 32.83)	4.54 (± 2.5)	0 (± 0)	0.64 (± 0.17)	1.7 (± 1.04)
Extreme climate events - IM	79.52 (± 122.73)	2.16 (± 1.51)	1.15 (± 0.35)	17.35 (± 29.71)	4.5 (± 2.5)	0 (± 0)	0.61 (± 0.12)	1.99 (± 3.13)
Blooms - IM	49.29 (± 73.42)	2.28 (± 1.56)	1.12 (± 0.27)	16.55 (± 28.26)	4.49 (± 2.47)	0 (± 0)	0.63 (± 0.09)	1.27 (± 0.36)
Primary production regime shift - IM	75.78 (± 115.56)	2.21 (± 1.33)	0.88 (± 0.5)	15.34 (± 26.18)	9.4 (± 8.88)	0.01 (± 0.01)	0.63 (± 0.1)	2.61 (± 1.37)
Fish kills - IM	77.14 (± 124.66)	2.27 (± 1.58)	1.14 (± 0.2)	17.02 (± 29.12)	4.5 (± 2.48)	0 (± 0)	0.62 (± 0.11)	3.13 (± 2.16)
Range extensions - IM	73.92 (± 104.38)	1.75 (± 1.21)	1.53 (± 2.19)	14.29 (± 24.34)	7.81 (± 9.62)	0.01 (± 0.01)	0.58 (± 0.15)	11.84 (± 12.66)
Gear switching allowed - IM	27.43 (± 26.08)	1.74 (± 1.24)	0.06 (± 0.08)	13.95 (± 23.84)	3.03 (± 1.67)	0 (± 0)	0.52 (± 0.13)	7.92 (± 9.92)
High compliance - IM	13.22 (± 14.87)	1.66 (± 1.14)	1.17 (± 1.6)	17.32 (± 29.66)	3.13 (± 1.73)	0 (± 0)	0.59 (± 0.14)	0.45 (± 0.24)
Low Compliance - IM	35.61 (± 41.01)	1.82 (± 1.26)	1.32 (± 1.69)	14.74 (± 25.2)	3.11 (± 1.69)	0 (± 0)	0.6 (± 0.14)	8.51 (± 13.39)
Flexible fisher behaviour - IM	14 (± 11.91)	1.95 (± 1.34)	0.28 (± 0.15)	15.15 (± 25.87)	9.05 (± 4.99)	0.01 (± 0.01)	0.67 (± 0.17)	1.64 (± 1.89)
Increased fishing pressure drivers - IM	14.97 (± 15.36)	1.67 (± 1.15)	0.35 (± 0.2)	14.32 (± 24.48)	3.13 (± 1.73)	0 (± 0)	0.57 (± 0.11)	23.39 (± 31.79)
High Cost, Low Values - IM	4.57 (± 3.85)	1.96 (± 1.34)	0 (± 0.01)	11.44 (± 19.61)	2.8 (± 1.55)	0 (± 0)	0.35 (± 0.06)	8473.88 (± 14661.73)
Low Costs, High Values - IM	12.17 (± 9.68)	1.68 (± 1.15)	0.3 (± 0.08)	16.96 (± 29.05)	3.14 (± 1.73)	0 (± 0)	0.55 (± 0.12)	3.58 (± 4.67)
Standard Markets - IM	16.61 (± 17.42)	1.67 (± 1.15)	0.31 (± 0.14)	13.3 (± 22.71)	3.15 (± 1.75)	0 (± 0)	0.56 (± 0.12)	9.95 (± 8.49)
Technology Creep - IM	42.53 (± 49.54)	2.22 (± 1.53)	0.26 (± 0.32)	24.11 (± 41.17)	6.26 (± 3.45)	0.01 (± 0)	0.61 (± 0.15)	3.93 (± 4.7)
No Acclimation - 2010 coastal context - IM	8.04 (± 6.65)	89.38 (± 61.44)	0.14 (± 0.24)	13.68 (± 23.39)	26.25 (± 9.16)	0.04 (± 0.03)	0.91 (± 0.17)	19.85 (± 17.11)
No Acclimation - Cumulative impacts - SQ	42.64 (± 37.86)	88.04 (± 60.15)	0.07 (± 0.11)	12.64 (± 21.74)	25.49 (± 10.67)	0.04 (± 0.03)	0.84 (± 0.24)	21.65 (± 36.55)

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
No Climate change - 2010 context - SQ	7.96 (± 0.59)	1.92 (± 0.09)	0.44 (± 0.27)	4.08 (± 0.27)	0 (± 0)	7.39 (± 0.48)	0 (± 0)
2010 coastal context - Cap ecosystem take	2.37 (± 0.51)	3.13 (± 1.73)	0.17 (± 0.08)	3.94 (± 0.44)	0 (± 0)	9.06 (± 2.1)	0 (± 0)
2010 coastal context - Centralised mgmt.	2.38 (± 0.51)	3.08 (± 1.63)	0.17 (± 0.07)	4.82 (± 0.81)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
2010 coastal context - FewMPA	2.02 (± 0.44)	1.66 (± 0.63)	0.11 (± 0.05)	3.93 (± 0.55)	0 (± 0)	10.33 (± 0.14)	0 (± 0)
2010 coastal context - Fragmented mgmt	2.37 (± 0.51)	3.11 (± 1.77)	0.17 (± 0.08)	4.18 (± 0.46)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
2010 coastal context - ManyMPA	2.52 (± 0.58)	1.25 (± 0.75)	0.05 (± 0.02)	2.87 (± 0.12)	0 (± 0)	10.35 (± 0.15)	0 (± 0)
2010 coastal context - Seasons	1.4 (± 0.3)	2.3 (± 1.23)	0.17 (± 0.08)	8.17 (± 1.21)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
2010 coastal context - SlowAssess	11.32 (± 8.21)	2.26 (± 1.05)	0.4 (± 0.18)	4.34 (± 1.14)	0 (± 0)	6.44 (± 3.62)	0 (± 0)
2010 coastal context - Integrated Mgmt (IM)	8.46 (± 5.89)	2.26 (± 1.12)	0.26 (± 0.09)	4.24 (± 1.2)	0 (± 0)	5.36 (± 1.5)	0 (± 0)

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
Cumulative impacts - 2010 Status Quo (SQ)	10.32 (± 2.22)	1.64 (± 0.89)	0.3 (± 0.18)	1.61 (± 0.16)	0 (± 0)	6.19 (± 0.09)	0 (± 0)
Cumulative impacts - Cap ecosystem take	10.31 (± 2.22)	1.65 (± 0.87)	0.31 (± 0.18)	1.47 (± 0.19)	0 (± 0)	5.44 (± 1.26)	0 (± 0)
Cumulative impacts - Centralised mgmt.	10.32 (± 2.22)	1.63 (± 0.81)	0.3 (± 0.17)	1.45 (± 0.39)	0 (± 0)	6.19 (± 0.09)	0 (± 0)
Cumulative impacts - FewMPA	8.77 (± 1.91)	0.88 (± 0.31)	0.19 (± 0.12)	1.46 (± 0.24)	0 (± 0)	6.2 (± 0.09)	0 (± 0)
Cumulative impacts - Fragmented mgmt	10.32 (± 2.23)	1.65 (± 0.89)	0.3 (± 0.17)	1.55 (± 0.2)	0 (± 0)	6.19 (± 0.09)	0 (± 0)
Cumulative impacts - ManyMPA	10.93 (± 2.54)	0.66 (± 0.38)	0.08 (± 0.05)	0.13 (± 0.01)	0 (± 0)	6.21 (± 0.09)	0 (± 0)
Cumulative impacts - Seasons	6.09 (± 1.32)	1.22 (± 0.62)	0.29 (± 0.18)	3.04 (± 0.51)	0 (± 0)	6.19 (± 0.09)	0 (± 0)
Cumulative impacts - SlowAssess	5.21 (± 3.55)	2.39 (± 1.44)	0.29 (± 0.18)	2.33 (± 0.66)	0 (± 0)	8.79 (± 2.36)	0 (± 0)
Cumulative impacts - IM	4.64 (± 4.03)	2.37 (± 1.49)	0.24 (± 0.23)	2.29 (± 0.71)	0 (± 0)	5.57 (± 1.66)	0 (± 0)
Expanded LTL fishery - IM	2.38 (± 0.51)	3.13 (± 1.72)	0.18 (± 0.08)	4.23 (± 0.46)	Major fishery	10.34 (± 0.15)	Active fishery
New mesopelgic fishery - IM	2.66 (± 0.57)	3.37 (± 1.59)	0.22 (± 0.1)	5.73 (± 0.67)	0 (± 0)	10.34 (± 0.15)	0 (± 0)
Extreme climate events - IM	2.65 (± 0.57)	3.3 (± 1.66)	0.21 (± 0.1)	5.38 (± 0.78)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
Blooms - IM	2.65 (± 0.57)	3.53 (± 2.07)	0.22 (± 0.1)	5.19 (± 0.7)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
Primary production regime shift - IM	3.36 (± 1.13)	3.49 (± 2.02)	0.56 (± 0.68)	5.66 (± 0.8)	0 (± 0)	8.53 (± 3.25)	0 (± 0)
Fish kills - IM	2.66 (± 0.57)	3.39 (± 1.81)	0.21 (± 0.1)	5.65 (± 1.08)	Major fishery	10.32 (± 0.15)	Active fishery
Range extensions - IM	2.99 (± 0.86)	3.14 (± 1.66)	0.24 (± 0.06)	4.13 (± 0.48)	0 (± 0)	10.33 (± 0.15)	0 (± 0)
Gear switching allowed - IM	2.23 (± 0.48)	2.81 (± 1.52)	0.17 (± 0.07)	6.1 (± 0.98)	0 (± 0)	10.33 (± 0.15)	0 (± 0)
High compliance - IM	2.37 (± 0.51)	3.21 (± 1.78)	0.18 (± 0.08)	3.87 (± 0.24)	Major fishery	10.32 (± 0.15)	Active fishery
Low Compliance - IM	2.37 (± 0.51)	3.23 (± 1.66)	0.19 (± 0.09)	3.71 (± 0.68)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
Flexible fisher behaviour - IM	6.89 (± 1.48)	3.64 (± 1.95)	0.28 (± 0.13)	3.76 (± 0.82)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
Increased fishing pressure drivers - IM	2.37 (± 0.51)	3.13 (± 1.73)	0.17 (± 0.08)	3.94 (± 0.44)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
High Cost, Low Values - IM	2.09 (± 0.45)	1.96 (± 1.14)	0.14 (± 0.06)	5.52 (± 1.09)	Major fishery	10.33 (± 0.15)	Active fishery
Low Costs, High Values - IM	2.37 (± 0.51)	3 (± 1.65)	0.17 (± 0.08)	4.21 (± 0.48)	Major fishery	10.51 (± 0.44)	Active fishery
Standard Markets - IM	2.38 (± 0.51)	3.1 (± 1.79)	0.17 (± 0.08)	4.32 (± 0.34)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
Technology Creep - IM	4.66 (± 1)	3.31 (± 1.87)	0.37 (± 0.16)	5.98 (± 0.44)	0 (± 0)	10.32 (± 0.15)	0 (± 0)
No Acclimation - 2010 coastal context - IM	0.54 (± 0.11)	5 (± 2.77)	3.22 (± 1.49)	6.83 (± 0.76)	0 (± 0)	5.01 (± 0.49)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0.52 (± 0.09)	4.41 (± 1.94)	2.91 (± 1.47)	6.38 (± 1.37)	0 (± 0)	7.03 (± 0.56)	0 (± 0)

Table A. 11: Mean relative landings (± s.e.) of each fished group in Atlantis-SEAP for each strategy-scenario combination under RCP 4.5. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics and new fisheries "Active fishery" or "Major fishery" is noted as there is no fishery initially.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.47 (± 0.39)	1.15 (± 0.41)	44.39 (± 1.04)	4.94 (± 3.53)	20.81 (± 25.87)	1.36 (± 1.17)	4.1 (± 4.05)	0.39 (± 0.26)
2010 coastal context - Cap ecosystem take	0.85 (± 0.89)	0.49 (± 0.3)	5.79 (± 7.42)	2.51 (± 1.12)	224.28 (± 318.58)	2.97 (± 4.6)	2.8 (± 1.59)	0.13 (± 0.08)
2010 coastal context - Centralised mgmt.	0.85 (± 0.89)	0.53 (± 0.53)	5.78 (± 7.46)	2.5 (± 1.14)	219.24 (± 308.26)	0.32 (± 0.28)	6.5 (± 0.8)	0.13 (± 0.08)
2010 coastal context - FewMPA	0.86 (± 0.9)	0.68 (± 1.13)	3.36 (± 4.4)	2.67 (± 1.34)	116.35 (± 109.81)	9.44 (± 15.35)	8.22 (± 3.19)	0.14 (± 0.1)
2010 coastal context - Fragmented mgmt	0.85 (± 0.89)	0.69 (± 0.76)	5.76 (± 7.45)	2.52 (± 1.17)	292.02 (± 453.52)	2.18 (± 3.45)	5.23 (± 3.56)	0.13 (± 0.08)
2010 coastal context - ManyMPA	0.83 (± 0.85)	2.63 (± 3.46)	4.53 (± 5.88)	2.22 (± 1.05)	245.25 (± 251.89)	7.71 (± 12.47)	0.13 (± 0.13)	0.12 (± 0.08)
2010 coastal context - Seasons	0.57 (± 0.6)	0.7 (± 1.04)	4.06 (± 5.57)	0.02 (± 0.01)	43.98 (± 52.8)	14.09 (± 22.64)	3.67 (± 2.39)	0 (± 0)
2010 coastal context - SlowAssess	0.67 (± 1.03)	0.23 (± 0.22)	6.36 (± 8.4)	1.32 (± 0.68)	50.88 (± 54.16)	104.02 (± 151.36)	3.88 (± 0.76)	0.07 (± 0.01)
2010 coastal context - Integrated Mgmt (IM)	0.67 (± 1.03)	0.48 (± 0.26)	6.31 (± 8.31)	1.33 (± 0.69)	112.1 (± 159.73)	126.82 (± 109.99)	4.78 (± 1.34)	0.07 (± 0.01)
Cumulative impacts - 2010 Status Quo (SQ)	0.38 (± 0.54)	0.27 (± 0.38)	5.86 (± 7.75)	1.11 (± 0.67)	27.49 (± 34.64)	17.68 (± 13.84)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - Cap ecosystem take	0.38 (± 0.54)	0.18 (± 0.16)	5.87 (± 7.72)	1.1 (± 0.65)	38.61 (± 46.72)	11.51 (± 7.14)	0 (± 0)	0.06 (± 0.02)
Cumulative impacts - Centralised mgmt.	0.38 (± 0.54)	0.21 (± 0.26)	5.86 (± 7.76)	1.1 (± 0.65)	38.74 (± 44.82)	7.81 (± 7.41)	0 (± 0)	0.06 (± 0.02)
Cumulative impacts - FewMPA	0.39 (± 0.55)	0.3 (± 0.51)	3.41 (± 4.58)	1.18 (± 0.75)	21.64 (± 15.36)	29.8 (± 26.6)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - Fragmented mgmt	0.38 (± 0.54)	0.28 (± 0.37)	5.85 (± 7.76)	1.11 (± 0.67)	47.6 (± 68.4)	7.76 (± 5.31)	0 (± 0)	0.06 (± 0.03)
Cumulative impacts - ManyMPA	0.37 (± 0.52)	1.11 (± 1.62)	4.6 (± 6.12)	0.98 (± 0.6)	48.98 (± 37.71)	24.91 (± 21.24)	0 (± 0)	0.05 (± 0.02)
Cumulative impacts - Seasons	0.26 (± 0.36)	0.3 (± 0.48)	4.13 (± 5.79)	0.01 (± 0.01)	8.32 (± 7.59)	46.55 (± 37.13)	0 (± 0)	0 (± 0)
Cumulative impacts - SlowAssess	0.57 (± 0.41)	0.1 (± 0.13)	5.42 (± 6.97)	2.3 (± 1.48)	74.38 (± 73.15)	3.93 (± 6.36)	0 (± 0)	0.12 (± 0.1)
Cumulative impacts - IM	0.56 (± 0.41)	0.19 (± 0.18)	5.38 (± 6.9)	2.28 (± 1.43)	102.72 (± 91.1)	19.67 (± 33.67)	0 (± 0)	0.12 (± 0.1)
Expanded LTL fishery - IM	0.85 (± 0.89)	0.54 (± 0.58)	5.67 (± 7.34)	2.55 (± 1.2)	206.36 (± 267.17)	0.09 (± 0.15)	4.62 (± 3.59)	0.13 (± 0.09)
New mesopelgic fishery - IM	0.92 (± 0.96)	0.36 (± 0.53)	13.74 (± 18.56)	0.03 (± 0.01)	439.31 (± 660.31)	0.95 (± 1.61)	5.02 (± 3.58)	0 (± 0)
Extreme climate events - IM	0.92 (± 0.97)	0.22 (± 0.31)	13.36 (± 17.9)	0.03 (± 0.01)	452.49 (± 680.74)	1.73 (± 2.52)	2.53 (± 2.11)	0 (± 0)
Blooms - IM	0.92 (± 0.96)	0.17 (± 0.24)	13.41 (± 18.04)	0.03 (± 0.01)	458.81 (± 686.03)	5.64 (± 8.96)	1.7 (± 2.36)	0 (± 0)
Primary production regime shift - IM	0.95 (± 1.01)	0.24 (± 0.2)	13.3 (± 17.89)	0.03 (± 0.01)	454.13 (± 680.32)	2.55 (± 3.97)	3.96 (± 3.56)	0 (± 0)
Fish kills - IM	0.92 (± 0.97)	0.1 (± 0.12)	13.38 (± 17.94)	0.03 (± 0.01)	433.15 (± 655.89)	2.78 (± 4.6)	4.77 (± 5.34)	0 (± 0)
Range extensions - IM	0.85 (± 0.89)	0.61 (± 0.62)	5.8 (± 7.42)	2.53 (± 1.17)	87.22 (± 85.39)	3.43 (± 5.53)	9.05 (± 2.15)	0.13 (± 0.08)
Gear switching allowed - IM	0.84 (± 0.88)	0.85 (± 1.16)	3.35 (± 4.35)	2.65 (± 1.33)	80.03 (± 38.54)	8.63 (± 14.5)	8.38 (± 7.01)	0.14 (± 0.09)
High compliance - IM	0.85 (± 0.89)	0.53 (± 0.37)	5.7 (± 7.35)	2.52 (± 1.13)	139.83 (± 142.86)	0.28 (± 0.26)	5.72 (± 3.7)	0.13 (± 0.08)
Low Compliance - IM	0.85 (± 0.89)	0.88 (± 1.3)	5.99 (± 7.69)	2.54 (± 1.23)	86.61 (± 39.91)	5.65 (± 9.12)	3.62 (± 3.56)	0.13 (± 0.09)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
Flexible fisher behaviour - IM	2.35 (± 2.45)	0.52 (± 0.33)	15.07 (± 19.37)	7.05 (± 3.31)	183.62 (± 231.89)	0.14 (± 0.25)	10.2 (± 9.47)	0.37 (± 0.24)
Increased fishing pressure drivers - IM	0.85 (± 0.89)	0.49 (± 0.3)	5.79 (± 7.42)	2.51 (± 1.12)	224.28 (± 318.58)	5.44 (± 8.8)	4.46 (± 1.38)	0.13 (± 0.08)
High Cost, Low Values - IM	0.86 (± 0.9)	0.43 (± 0.53)	3.34 (± 4.37)	2.66 (± 1.32)	143.46 (± 86.1)	9.24 (± 14.98)	6.91 (± 3.33)	0.14 (± 0.09)
Low Costs, High Values - IM	0.85 (± 0.88)	0.54 (± 0.33)	5.77 (± 7.45)	2.53 (± 1.16)	285.89 (± 440.3)	0.88 (± 1.49)	3.62 (± 1.81)	0.13 (± 0.08)
Standard Markets - IM	0.85 (± 0.89)	0.64 (± 0.79)	5.78 (± 7.45)	2.52 (± 1.17)	161.71 (± 234.77)	5.27 (± 8.45)	5.23 (± 1.87)	0.13 (± 0.08)
Technology Creep - IM	1.62 (± 1.7)	0.8 (± 1.11)	9.61 (± 12.33)	5.08 (± 2.46)	206.73 (± 151.51)	3.5 (± 6.05)	8.42 (± 2.81)	0.26 (± 0.18)
No Acclimation - 2010 coastal context - IM	0 (± 0)	2.11 (± 1.32)	0.06 (± 0.08)	0.11 (± 0.05)	0 (± 0)	0.33 (± 0.32)	0 (± 0)	0.01 (± 0)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	1.61 (± 1.46)	0.06 (± 0.07)	0.11 (± 0.05)	0 (± 0)	0.59 (± 0.96)	0 (± 0)	0.01 (± 0)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.96 (± 0.85)	0 (± 0)	0 (± 0)	9.71 (± 10.99)	15.51 (± 4.44)	28.86 (± 25.33)	20.33 (± 16.28)	2.87 (± 1.91)
2010 coastal context - Cap ecosystem take	0.45 (± 0.4)	0 (± 0)	0 (± 0)	40.36 (± 60.92)	143.02 (± 56.07)	15.81 (± 7.54)	17.06 (± 20.92)	5.66 (± 3.41)
2010 coastal context - Centralised mgmt.	0.33 (± 0.24)	0 (± 0)	0 (± 0)	11.81 (± 12.88)	158.85 (± 93.25)	36.08 (± 18.14)	11.12 (± 11.27)	4.87 (± 3.13)
2010 coastal context - FewMPA	0.47 (± 0.57)	0 (± 0)	0 (± 0)	17.73 (± 27.13)	190.26 (± 84.74)	48.54 (± 10.81)	11.14 (± 7.72)	3.15 (± 2.75)
2010 coastal context - Fragmented mgmt	1.07 (± 1.02)	0 (± 0)	0 (± 0)	72.86 (± 61.38)	166.99 (± 35.14)	17.08 (± 12.29)	12.36 (± 14.09)	4.8 (± 3.97)
2010 coastal context - ManyMPA	0.65 (± 0.19)	0 (± 0)	0 (± 0)	9.88 (± 6.64)	11.33 (± 16.13)	0.52 (± 0.56)	15.73 (± 13.48)	10.95 (± 3.02)
2010 coastal context - Seasons	0.85 (± 0.96)	0 (± 0)	0 (± 0)	30.96 (± 45.89)	169.48 (± 49.32)	41.16 (± 12.98)	14.9 (± 12.52)	4.78 (± 3.12)
2010 coastal context - SlowAssess	0.59 (± 0.4)	0 (± 0)	0 (± 0)	48.83 (± 63.64)	145.04 (± 46.68)	48.96 (± 34.12)	16.49 (± 15.69)	7.4 (± 6.24)
2010 coastal context - Integrated Mgmt (IM)	0.87 (± 0.74)	0 (± 0)	0 (± 0)	17.89 (± 23)	134.44 (± 24.82)	12.91 (± 0.59)	15.73 (± 12.25)	12.79 (± 9.85)
Cumulative impacts - 2010 Status Quo (SQ)	0.4 (± 0.24)	0 (± 0)	0 (± 0)	28.56 (± 37.98)	95.55 (± 125.64)	0 (± 0)	15.17 (± 17.58)	3.38 (± 4.49)
Cumulative impacts - Cap ecosystem take	0.53 (± 0.25)	0 (± 0)	0 (± 0)	6.98 (± 9.15)	68.64 (± 94.47)	0 (± 0)	11.37 (± 11.35)	7.88 (± 11.72)
Cumulative impacts - Centralised mgmt.	0.32 (± 0.24)	0 (± 0)	0 (± 0)	2.35 (± 1.6)	90.43 (± 126.6)	0 (± 0)	10.33 (± 10.09)	5.86 (± 9.58)
Cumulative impacts - FewMPA	0.31 (± 0.31)	0 (± 0)	0 (± 0)	3.38 (± 3.96)	72.91 (± 67.2)	0 (± 0)	11.5 (± 9.93)	9.32 (± 15.34)
Cumulative impacts - Fragmented mgmt	0.42 (± 0.26)	0 (± 0)	0 (± 0)	29.19 (± 37.61)	75.06 (± 91.78)	0 (± 0)	10.07 (± 9.61)	3.45 (± 4.45)
Cumulative impacts - ManyMPA	0.79 (± 0.72)	0 (± 0)	0 (± 0)	17.5 (± 21.64)	4.04 (± 6.64)	0 (± 0)	12.1 (± 10.42)	28.17 (± 44.16)
Cumulative impacts - Seasons	0.24 (± 0.24)	0 (± 0)	0 (± 0)	6.11 (± 6.63)	30.71 (± 36.18)	0 (± 0)	12.57 (± 10.82)	19.65 (± 32.66)
Cumulative impacts - SlowAssess	0.62 (± 0.58)	0 (± 0)	0 (± 0)	7.61 (± 10.96)	42.17 (± 48.77)	0 (± 0)	10.16 (± 14.95)	5.9 (± 9.03)
Cumulative impacts - IM	0.48 (± 0.45)	0 (± 0)	0 (± 0)	16.06 (± 24.1)	70.88 (± 105.63)	0 (± 0)	13.83 (± 20.11)	12.54 (± 19.73)
Expanded LTL fishery - IM	0.67 (± 0.6)	0 (± 0)	0 (± 0)	10.59 (± 13.81)	119.66 (± 99.98)	42.74 (± 17.6)	16.49 (± 16.08)	9.03 (± 10.75)
New mesopelgic fishery - IM	0.33 (± 0.06)	Major fishery	Major fishery	10.36 (± 6.77)	127 (± 31.66)	39.83 (± 19.89)	14.62 (± 14.56)	9.7 (± 5.74)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Extreme climate events - IM	0.72 (± 0.48)	0 (± 0)	0 (± 0)	24.87 (± 26.84)	48.83 (± 46.93)	8.63 (± 8.11)	14.62 (± 19.32)	21.74 (± 20.55)
Blooms - IM	0.73 (± 0.55)	0 (± 0)	0 (± 0)	26.26 (± 29.43)	59.78 (± 55.16)	5.4 (± 5.71)	12.93 (± 16.49)	22.98 (± 22.62)
Primary production regime shift - IM	0.68 (± 0.56)	0 (± 0)	0 (± 0)	23.76 (± 28.79)	179.88 (± 137.82)	19.17 (± 29.09)	14.84 (± 18.41)	20.2 (± 22.31)
Fish kills - IM	0.76 (± 0.45)	0 (± 0)	0 (± 0)	26.02 (± 26.24)	53.97 (± 53.6)	3.58 (± 4.34)	10.42 (± 14.27)	19.73 (± 21.96)
Range extensions - IM	0.66 (± 0.81)	0 (± 0)	0 (± 0)	26.52 (± 37.97)	184.95 (± 39.94)	42.65 (± 30.45)	15.77 (± 17.99)	22.31 (± 29.82)
Gear switching allowed - IM	0.83 (± 0.6)	0 (± 0)	0 (± 0)	21.95 (± 18.46)	185.56 (± 42.39)	31.55 (± 9.43)	21.7 (± 17.47)	13.74 (± 17.77)
High compliance - IM	0.32 (± 0.2)	0 (± 0)	0 (± 0)	11.06 (± 11.39)	170.83 (± 89.77)	31.09 (± 22.11)	14.72 (± 18.5)	9.77 (± 8.72)
Low Compliance - IM	0.83 (± 0.68)	0 (± 0)	0 (± 0)	20.93 (± 18.35)	179.94 (± 42.07)	11.57 (± 12.28)	13.04 (± 16.26)	12.23 (± 17.43)
Flexible fisher behaviour - IM	0.33 (± 0.17)	0 (± 0)	0 (± 0)	11.43 (± 10.5)	209.76 (± 35.06)	53.37 (± 13.7)	17.85 (± 19.44)	10.37 (± 8.14)
Increased fishing pressure drivers - IM	0.45 (± 0.4)	0 (± 0)	0 (± 0)	40.36 (± 60.92)	197.04 (± 76.59)	15.81 (± 7.54)	17.06 (± 20.92)	33.53 (± 48.16)
High Cost, Low Values - IM	0.6 (± 0.53)	0 (± 0)	0 (± 0)	43.24 (± 38.85)	214.7 (± 58)	54.63 (± 24.31)	19.59 (± 16.35)	14.11 (± 21.96)
Low Costs, High Values - IM	1.53 (± 0.33)	0 (± 0)	0 (± 0)	44.33 (± 20.67)	209.23 (± 45.2)	17.31 (± 10.68)	15.52 (± 19.73)	22.15 (± 17.13)
Standard Markets - IM	0.98 (± 0.87)	0 (± 0)	0 (± 0)	68.83 (± 59.48)	199.73 (± 15.78)	19.89 (± 5.85)	13.85 (± 15.74)	23.89 (± 36.37)
Technology Creep - IM	0.51 (± 0.55)	0 (± 0)	0 (± 0)	35.22 (± 53.81)	187.63 (± 32.13)	43.38 (± 19.81)	20.31 (± 17.08)	29.06 (± 42.68)
No Acclimation - 2010 coastal context - IM	0.81 (± 0.03)	0 (± 0)	0 (± 0)	13.56 (± 11.35)	227.18 (± 63.39)	0 (± 0)	10.84 (± 16.01)	12.44 (± 3.7)
No Acclimation - Cumulative impacts - SQ	0.45 (± 0.19)	0 (± 0)	0 (± 0)	6.85 (± 6.08)	193.04 (± 88.45)	0 (± 0)	9.41 (± 14.69)	8.94 (± 5.97)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	0 (± 0)	21288.64 (± 26347.33)	2.7 (± 1.91)	1.28 (± 0.88)	1.24 (± 1.86)	36.88 (± 0.28)	1.5 (± 0.02)	0.39 (± 0.01)
2010 coastal context - Cap ecosystem take	0 (± 0)	410.31 (± 304)	2.31 (± 0.39)	1.84 (± 0.82)	1.05 (± 0.21)	12.16 (± 5.31)	0.19 (± 0.07)	0.54 (± 0.31)
2010 coastal context - Centralised mgmt.	0 (± 0)	358.1 (± 450.67)	3.15 (± 1.26)	1.78 (± 1.05)	1.07 (± 0.23)	12.12 (± 5.41)	0.21 (± 0.12)	0.4 (± 0.19)
2010 coastal context - FewMPA	0 (± 0)	334.17 (± 430.94)	1.49 (± 0.83)	2.38 (± 1.76)	0.6 (± 0.15)	12.93 (± 6.32)	0.09 (± 0.1)	0.74 (± 0.82)
2010 coastal context - Fragmented mgmt	0 (± 0)	277.94 (± 198.62)	3.09 (± 1.92)	1.61 (± 1)	1.07 (± 0.22)	12.21 (± 5.53)	0.21 (± 0.11)	0.42 (± 0.21)
2010 coastal context - ManyMPA	0 (± 0)	537.36 (± 369.91)	2.01 (± 0.23)	1.42 (± 1.18)	1.13 (± 0.26)	10.77 (± 4.97)	0.06 (± 0.06)	0.69 (± 0.65)
2010 coastal context - Seasons	0 (± 0)	225.09 (± 184.91)	1.34 (± 0.03)	2.06 (± 1.61)	1.77 (± 2.59)	0.09 (± 0.04)	0.12 (± 0.11)	1.24 (± 1.16)
2010 coastal context - SlowAssess	0 (± 0)	347.11 (± 423.4)	3.33 (± 0.83)	0.91 (± 0.89)	1.32 (± 1)	7.59 (± 1.41)	0.05 (± 0.07)	0.08 (± 0.14)
2010 coastal context - Integrated Mgmt (IM)	0 (± 0)	278.66 (± 153.22)	3.12 (± 1.08)	1.34 (± 1.26)	1.27 (± 0.94)	7.57 (± 1.36)	0.08 (± 0.13)	0.28 (± 0.47)
Cumulative impacts - 2010 Status Quo (SQ)	0 (± 0)	195.73 (± 260.29)	1.5 (± 1.25)	0.46 (± 0.22)	1.82 (± 1.24)	6.46 (± 2.68)	0.01 (± 0.01)	0.32 (± 0.55)
Cumulative impacts - Cap ecosystem take	0 (± 0)	262.66 (± 345.66)	2.05 (± 1.63)	0.52 (± 0.58)	1.75 (± 1.18)	6.43 (± 2.56)	0 (± 0)	0.75 (± 1.3)
Cumulative impacts - Centralised mgmt.	0 (± 0)	113.51 (± 163.57)	1.45 (± 1.55)	0.36 (± 0.24)	1.77 (± 1.2)	6.41 (± 2.62)	0.01 (± 0.01)	0.38 (± 0.66)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
Cumulative impacts - FewMPA	0 (± 0)	217.01 (± 330.32)	0.69 (± 0.81)	0.74 (± 0.48)	0.98 (± 0.66)	6.83 (± 3.07)	0 (± 0)	0.44 (± 0.75)
Cumulative impacts - Fragmented mgmt	0 (± 0)	200.08 (± 257.79)	1.12 (± 1.67)	0.73 (± 0.68)	1.77 (± 1.2)	6.46 (± 2.68)	0.01 (± 0)	0.5 (± 0.87)
Cumulative impacts - ManyMPA	0 (± 0)	340.2 (± 344.36)	1.64 (± 1.12)	0.2 (± 0.12)	1.87 (± 1.28)	5.69 (± 2.41)	0 (± 0)	0.57 (± 0.98)
Cumulative impacts - Seasons	0 (± 0)	169.61 (± 218.34)	1.25 (± 1.35)	0.86 (± 0.58)	0.57 (± 0.42)	0.05 (± 0.02)	0 (± 0)	1.01 (± 1.74)
Cumulative impacts - SlowAssess	0 (± 0)	224.79 (± 322.94)	1.2 (± 1.68)	1.31 (± 1.12)	1.54 (± 0.93)	11.17 (± 7.26)	0.09 (± 0.14)	0.38 (± 0.34)
Cumulative impacts - IM	0 (± 0)	224.45 (± 254.48)	0.6 (± 0.38)	0.99 (± 1.22)	1.51 (± 0.79)	11.01 (± 7.03)	0.06 (± 0.09)	0.89 (± 1.19)
Expanded LTL fishery - IM	0 (± 0)	257.67 (± 317.25)	3.17 (± 2.55)	1.99 (± 0.69)	1.11 (± 0.26)	12.38 (± 5.69)	0.22 (± 0.14)	0.37 (± 0.22)
New mesopelgic fishery - IM	0 (± 0)	243.02 (± 243.28)	1.82 (± 1.05)	1.54 (± 0.37)	0.87 (± 0.18)	0.15 (± 0.07)	0.04 (± 0.02)	0.64 (± 0.43)
Extreme climate events - IM	0 (± 0)	316.81 (± 215.07)	1.91 (± 0.89)	1.46 (± 0.46)	0.86 (± 0.18)	0.14 (± 0.06)	0.04 (± 0.03)	0.73 (± 0.5)
Blooms - IM	0 (± 0)	218.22 (± 21.96)	2.17 (± 1.29)	1.46 (± 0.27)	0.8 (± 0.09)	0.15 (± 0.07)	0.03 (± 0.03)	0.48 (± 0.39)
Primary production regime shift - IM	0 (± 0)	264.13 (± 183.21)	2.18 (± 1.01)	1.86 (± 0.26)	0.84 (± 0.15)	0.15 (± 0.07)	0.05 (± 0.02)	0.63 (± 0.22)
Fish kills - IM	0 (± 0)	374.51 (± 276.53)	1.41 (± 0.66)	1.94 (± 0.26)	0.81 (± 0.17)	0.14 (± 0.07)	0.04 (± 0.03)	0.52 (± 0.26)
Range extensions - IM	0 (± 0)	424.44 (± 433.59)	2.2 (± 1.77)	2.11 (± 0.7)	1.03 (± 0.29)	12.3 (± 5.55)	0.18 (± 0.12)	0.39 (± 0.29)
Gear switching allowed - IM	0 (± 0)	101.91 (± 43.39)	2.08 (± 1.86)	1.18 (± 0.93)	0.58 (± 0.14)	12.83 (± 6.25)	0.53 (± 0.54)	0.42 (± 0.42)
High compliance - IM	0 (± 0)	428.97 (± 587.34)	1.71 (± 1.76)	1.64 (± 0.49)	1.08 (± 0.23)	12.22 (± 5.34)	0.25 (± 0.14)	0.57 (± 0.39)
Low Compliance - IM	0 (± 0)	88.97 (± 47.29)	1.91 (± 2.68)	2.32 (± 0.87)	1.13 (± 0.26)	12.31 (± 5.79)	0.35 (± 0.34)	0.67 (± 0.6)
Flexible fisher behaviour - IM	0 (± 0)	438.12 (± 579.2)	1.77 (± 1.62)	1.61 (± 0.54)	2.24 (± 0.47)	30.43 (± 9.73)	0.24 (± 0.12)	0.53 (± 0.41)
Increased fishing pressure drivers - IM	0 (± 0)	539.5 (± 513.1)	1.06 (± 0.54)	1.82 (± 0.85)	1.06 (± 0.21)	12.16 (± 5.31)	0.19 (± 0.07)	0.54 (± 0.31)
High Cost, Low Values - IM	16.65 (± 15.08)	163.73 (± 130.42)	1.52 (± 1.27)	1.11 (± 0.87)	0.61 (± 0.16)	12.89 (± 6.19)	0.27 (± 0.28)	0.73 (± 0.7)
Low Costs, High Values - IM	7.1 (± 4.86)	630.71 (± 396.58)	3.03 (± 0.71)	1.68 (± 1.02)	1.06 (± 0.22)	12.25 (± 5.47)	0.26 (± 0.16)	0.57 (± 0.43)
Standard Markets - IM	0 (± 0)	264.6 (± 191.66)	2.33 (± 2.9)	1.68 (± 0.85)	1.08 (± 0.25)	12.22 (± 5.52)	0.2 (± 0.09)	0.37 (± 0.16)
Technology Creep - IM	3.51 (± 1.79)	528.1 (± 561.38)	1.21 (± 0.61)	1.54 (± 0.88)	1.68 (± 0.49)	24.58 (± 11.59)	0.41 (± 0.42)	0.57 (± 0.56)
No Acclimation - 2010 coastal context - IM	0 (± 0)	418.34 (± 12.32)	2.81 (± 0.99)	0 (± 0)	0.07 (± 0.1)	0.52 (± 0.23)	1.7 (± 0.6)	0.79 (± 0.46)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	361.39 (± 127.69)	1.68 (± 0.28)	0 (± 0)	0.07 (± 0.1)	0.53 (± 0.24)	1.47 (± 0.39)	0.48 (± 0.13)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
No Climate change - 2010 context - SQ	3.17 (± 2.16)	1.36 (± 1.02)	0.45 (± 0.59)	7.02 (± 0.14)	13.81 (± 8.21)	0.04 (± 0.01)	0.63 (± 0.22)	1.29 (± 0.81)
2010 coastal context - Cap ecosystem take	58.05 (± 60.94)	1.7 (± 1.17)	0.44 (± 0.3)	14.43 (± 24.66)	3.09 (± 1.71)	0 (± 0)	0.58 (± 0.08)	0.85 (± 0.24)
2010 coastal context - Centralised mgmt.	34.94 (± 23.1)	1.69 (± 1.16)	0.36 (± 0.2)	15.11 (± 25.82)	3.1 (± 1.71)	0 (± 0)	0.58 (± 0.12)	102.61 (± 169.72)
2010 coastal context - FewMPA	58.42 (± 52.74)	2.15 (± 1.48)	0.16 (± 0.14)	10.11 (± 17.35)	2.54 (± 1.4)	0 (± 0)	0.33 (± 0.09)	5.87 (± 8.94)
2010 coastal context - Fragmented mgmt	44.54 (± 45.21)	1.7 (± 1.17)	1.82 (± 2.51)	13.1 (± 22.35)	3.09 (± 1.7)	0 (± 0)	0.58 (± 0.1)	1.74 (± 1.63)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
2010 coastal context - ManyMPA	55.24 (± 92.23)	1.92 (± 1.34)	2.49 (± 4.19)	0.05 (± 0.09)	6.29 (± 3.64)	0.01 (± 0)	0.22 (± 0)	1.19 (± 0.99)
2010 coastal context - Seasons	17.02 (± 12.62)	8.34 (± 5.78)	0.18 (± 0.23)	19.42 (± 33.24)	2.57 (± 1.4)	0 (± 0)	0.43 (± 0.07)	808.19 (± 1397.89)
2010 coastal context - SlowAssess	11.99 (± 11.14)	9.6 (± 7.96)	1.87 (± 3.17)	16.23 (± 23.75)	56.55 (± 92.26)	0 (± 0)	0.59 (± 0.12)	302.67 (± 372.43)
2010 coastal context - Integrated Mgmt (IM)	43.8 (± 71.69)	7.55 (± 6.26)	0.28 (± 0.42)	15.89 (± 23.47)	16.21 (± 22.41)	0 (± 0)	0.58 (± 0.08)	51.39 (± 49.16)
Cumulative impacts - 2010 Status Quo (SQ)	7.81 (± 10.11)	7.87 (± 5.36)	0.05 (± 0.03)	15.58 (± 25.16)	20.29 (± 16.99)	0 (± 0)	0.49 (± 0.1)	36.53 (± 37.78)
Cumulative impacts - Cap ecosystem take	5.27 (± 6.81)	7.88 (± 5.37)	0.07 (± 0.06)	20.25 (± 33.29)	20.15 (± 16.87)	0 (± 0)	0.5 (± 0.09)	1.83 (± 2.83)
Cumulative impacts - Centralised mgmt.	21.55 (± 34.79)	7.87 (± 5.33)	0.05 (± 0.04)	23.38 (± 38.58)	20.23 (± 16.92)	0 (± 0)	0.5 (± 0.12)	6.07 (± 7.46)
Cumulative impacts - FewMPA	5.42 (± 4.92)	9.99 (± 6.82)	0.01 (± 0.01)	23.32 (± 39.48)	16.53 (± 13.82)	0 (± 0)	0.28 (± 0.09)	19.79 (± 32.57)
Cumulative impacts - Fragmented mgmt	4.45 (± 4.77)	7.89 (± 5.37)	0.06 (± 0.03)	14.21 (± 22.8)	20.16 (± 16.81)	0 (± 0)	0.49 (± 0.1)	5.42 (± 9.04)
Cumulative impacts - ManyMPA	2.68 (± 3.1)	8.9 (± 6.16)	0.01 (± 0.01)	0.24 (± 0.41)	41.17 (± 35.49)	0 (± 0)	0.19 (± 0.01)	28.08 (± 48.26)
Cumulative impacts - Seasons	2.93 (± 3.26)	38.75 (± 26.56)	0 (± 0)	20.26 (± 32.95)	16.75 (± 13.92)	0 (± 0)	0.37 (± 0.07)	4.01 (± 4.61)
Cumulative impacts - SlowAssess	47.79 (± 50.89)	2.65 (± 0.56)	0.13 (± 0.12)	20.67 (± 35.65)	12.8 (± 10.43)	0.01 (± 0.01)	0.51 (± 0.12)	4.42 (± 7.65)
Cumulative impacts - IM	7.15 (± 5.41)	2.12 (± 0.37)	0.14 (± 0.13)	19.62 (± 33.83)	8.79 (± 10.76)	0 (± 0)	0.5 (± 0.09)	0.64 (± 0.71)
Expanded LTL fishery - IM	27.44 (± 18.31)	1.69 (± 1.16)	1.26 (± 1.78)	15.76 (± 26.94)	3.1 (± 1.7)	0 (± 0)	0.59 (± 0.12)	1.31 (± 1.95)
New mesopelgic fishery - IM	43.1 (± 35.59)	2.09 (± 1.43)	1.21 (± 0.15)	19.3 (± 33.06)	4.48 (± 2.46)	0 (± 0)	0.65 (± 0.14)	1.17 (± 1.44)
Extreme climate events - IM	27.04 (± 20.02)	2.19 (± 1.53)	1.2 (± 0.35)	17.48 (± 29.92)	4.44 (± 2.46)	0 (± 0)	0.62 (± 0.09)	0.12 (± 0.13)
Blooms - IM	65.64 (± 80.82)	2.31 (± 1.6)	1.3 (± 0.14)	16.68 (± 28.46)	4.43 (± 2.43)	0 (± 0)	0.65 (± 0.07)	0.84 (± 0.82)
Primary production regime shift - IM	38.13 (± 19.19)	2.24 (± 1.36)	1.13 (± 0.3)	15.62 (± 26.66)	9.34 (± 8.92)	0.01 (± 0.01)	0.64 (± 0.07)	1.35 (± 1.49)
Fish kills - IM	25.64 (± 3.23)	2.3 (± 1.6)	1.19 (± 0.09)	17.15 (± 29.33)	4.44 (± 2.45)	0 (± 0)	0.63 (± 0.08)	0.36 (± 0.33)
Range extensions - IM	52.19 (± 25.78)	1.78 (± 1.24)	2.51 (± 3.96)	14.4 (± 24.51)	7.68 (± 9.43)	0.01 (± 0.01)	0.59 (± 0.12)	1.41 (± 1.25)
Gear switching allowed - IM	45.76 (± 28.98)	1.77 (± 1.27)	0.06 (± 0.08)	14.06 (± 24.01)	2.99 (± 1.64)	0 (± 0)	0.53 (± 0.11)	6.83 (± 10.64)
High compliance - IM	72.63 (± 68.68)	1.68 (± 1.16)	0.33 (± 0.18)	17.45 (± 29.87)	3.09 (± 1.7)	0 (± 0)	0.6 (± 0.11)	0.21 (± 0.19)
Low Compliance - IM	60.73 (± 46.51)	1.84 (± 1.29)	0.43 (± 0.32)	14.85 (± 25.38)	3.07 (± 1.66)	0 (± 0)	0.61 (± 0.11)	0.53 (± 0.44)
Flexible fisher behaviour - IM	61.14 (± 69)	1.98 (± 1.36)	0.35 (± 0.22)	15.26 (± 26.06)	8.93 (± 4.92)	0.01 (± 0.01)	0.69 (± 0.14)	1.35 (± 2.08)
Increased fishing pressure drivers - IM	58.05 (± 60.94)	1.7 (± 1.17)	0.44 (± 0.3)	14.43 (± 24.66)	3.09 (± 1.71)	0 (± 0)	0.58 (± 0.08)	3.44 (± 5.03)
High Cost, Low Values - IM	8.51 (± 2.45)	1.99 (± 1.37)	0.05 (± 0.08)	11.53 (± 19.75)	2.77 (± 1.53)	0 (± 0)	0.36 (± 0.05)	5.89 (± 9.18)
Low Costs, High Values - IM	70.3 (± 90.44)	1.7 (± 1.17)	0.36 (± 0.12)	17.09 (± 29.26)	3.1 (± 1.71)	0 (± 0)	0.56 (± 0.09)	0.6 (± 0.79)
Standard Markets - IM	23.63 (± 17.35)	1.69 (± 1.17)	0.37 (± 0.16)	13.4 (± 22.87)	3.11 (± 1.72)	0 (± 0)	0.57 (± 0.1)	1.74 (± 1.59)
Technology Creep - IM	60.52 (± 51.01)	2.25 (± 1.55)	0.1 (± 0.1)	24.29 (± 41.46)	6.17 (± 3.4)	0.01 (± 0)	0.62 (± 0.12)	4.36 (± 5.46)
No Acclimation - 2010 coastal context - IM	10.22 (± 5.15)	14.68 (± 3.49)	0.31 (± 0.53)	13.78 (± 23.55)	42.33 (± 23.39)	0.04 (± 0.03)	0.93 (± 0.13)	20.92 (± 17.97)
No Acclimation - Cumulative impacts - SQ	48.56 (± 40.04)	14.52 (± 3.5)	1.54 (± 2.2)	12.74 (± 21.9)	41.59 (± 25.16)	0.04 (± 0.03)	0.86 (± 0.2)	39.46 (± 50.66)

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
No Climate change - 2010 context - SQ	7.96 (± 0.59)	1.92 (± 0.09)	0.44 (± 0.27)	4.08 (± 0.27)	0 (± 0)	7.39 (± 0.48)	0 (± 0)
2010 coastal context - Cap ecosystem take	2.34 (± 0.49)	3.3 (± 2.08)	0.18 (± 0.08)	4.11 (± 0.48)	0 (± 0)	73.07 (± 110.98)	0 (± 0)
2010 coastal context - Centralised mgmt.	2.35 (± 0.5)	3.25 (± 1.97)	0.18 (± 0.08)	4.05 (± 1.04)	0 (± 0)	74.33 (± 109.85)	0 (± 0)
2010 coastal context - FewMPA	1.99 (± 0.43)	1.74 (± 0.79)	0.11 (± 0.05)	4.11 (± 0.67)	0 (± 0)	74.4 (± 109.97)	0 (± 0)
2010 coastal context - Fragmented mgmt	2.34 (± 0.5)	3.29 (± 2.13)	0.18 (± 0.08)	4.36 (± 0.48)	0 (± 0)	74.33 (± 109.86)	0 (± 0)
2010 coastal context - ManyMPA	2.48 (± 0.57)	1.32 (± 0.88)	0.05 (± 0.02)	3 (± 0.28)	0 (± 0)	74.52 (± 110.15)	0 (± 0)
2010 coastal context - Seasons	1.38 (± 0.29)	2.43 (± 1.48)	0.17 (± 0.08)	8.53 (± 1.3)	0 (± 0)	74.32 (± 109.84)	0 (± 0)
2010 coastal context - SlowAssess	11.13 (± 8.04)	2.36 (± 1.24)	0.41 (± 0.17)	4.53 (± 1.17)	0 (± 0)	70.22 (± 113.44)	0 (± 0)
2010 coastal context - Integrated Mgmt (IM)	8.32 (± 5.77)	2.38 (± 1.31)	0.27 (± 0.1)	4.42 (± 1.2)	0 (± 0)	49.99 (± 78.44)	0 (± 0)
Cumulative impacts - 2010 Status Quo (SQ)	10.19 (± 2.16)	1.73 (± 1.07)	0.31 (± 0.18)	1.68 (± 0.19)	0 (± 0)	44.6 (± 65.91)	0 (± 0)
Cumulative impacts - Cap ecosystem take	10.18 (± 2.15)	1.74 (± 1.04)	0.31 (± 0.18)	1.53 (± 0.22)	0 (± 0)	43.84 (± 66.58)	0 (± 0)
Cumulative impacts - Centralised mgmt.	10.19 (± 2.16)	1.72 (± 0.99)	0.31 (± 0.17)	1.51 (± 0.42)	0 (± 0)	44.59 (± 65.91)	0 (± 0)
Cumulative impacts - FewMPA	8.66 (± 1.85)	0.92 (± 0.39)	0.19 (± 0.12)	1.53 (± 0.29)	0 (± 0)	44.63 (± 65.98)	0 (± 0)
Cumulative impacts - Fragmented mgmt	10.18 (± 2.16)	1.74 (± 1.06)	0.31 (± 0.17)	1.62 (± 0.22)	0 (± 0)	44.6 (± 65.91)	0 (± 0)
Cumulative impacts - ManyMPA	10.79 (± 2.47)	0.7 (± 0.45)	0.08 (± 0.05)	0.14 (± 0.02)	0 (± 0)	44.71 (± 66.09)	0 (± 0)
Cumulative impacts - Seasons	6.01 (± 1.28)	1.28 (± 0.74)	0.29 (± 0.18)	3.18 (± 0.56)	0 (± 0)	44.59 (± 65.9)	0 (± 0)
Cumulative impacts - SlowAssess	5.17 (± 3.57)	2.52 (± 1.72)	0.29 (± 0.18)	2.41 (± 0.58)	0 (± 0)	47.31 (± 63.56)	0 (± 0)
Cumulative impacts - IM	4.61 (± 4.05)	2.51 (± 1.77)	0.24 (± 0.23)	2.36 (± 0.64)	0 (± 0)	32.43 (± 44.97)	0 (± 0)
Expanded LTL fishery - IM	2.35 (± 0.5)	3.31 (± 2.07)	0.18 (± 0.08)	4.41 (± 0.47)	Major fishery	74.44 (± 110.02)	Active fishery
New mesopelgic fishery - IM	2.63 (± 0.55)	3.54 (± 1.95)	0.22 (± 0.1)	5.98 (± 0.67)	0 (± 0)	74.44 (± 110.02)	0 (± 0)
Extreme climate events - IM	2.62 (± 0.55)	3.47 (± 2)	0.21 (± 0.11)	5.6 (± 0.7)	0 (± 0)	74.34 (± 109.87)	0 (± 0)
Blooms - IM	2.62 (± 0.55)	3.73 (± 2.47)	0.22 (± 0.11)	5.41 (± 0.69)	0 (± 0)	74.34 (± 109.87)	0 (± 0)
Primary production regime shift - IM	3.32 (± 1.15)	3.69 (± 2.41)	0.56 (± 0.68)	5.93 (± 1.13)	0 (± 0)	38.77 (± 48.28)	0 (± 0)
Fish kills - IM	2.62 (± 0.55)	3.58 (± 2.18)	0.22 (± 0.11)	5.89 (± 1.06)	Major fishery	74.33 (± 109.86)	Active fishery
Range extensions - IM	2.95 (± 0.82)	3.31 (± 2.01)	0.24 (± 0.05)	4.31 (± 0.45)	0 (± 0)	74.34 (± 109.87)	0 (± 0)
Gear switching allowed - IM	2.2 (± 0.47)	2.97 (± 1.84)	0.18 (± 0.08)	6.35 (± 0.92)	0 (± 0)	74.36 (± 109.9)	0 (± 0)
High compliance - IM	2.34 (± 0.49)	3.39 (± 2.14)	0.18 (± 0.08)	4.04 (± 0.39)	Major fishery	74.32 (± 109.85)	Active fishery
Low Compliance - IM	2.34 (± 0.49)	3.4 (± 2.01)	0.19 (± 0.09)	3.86 (± 0.66)	0 (± 0)	74.31 (± 109.83)	0 (± 0)
Flexible fisher behaviour - IM	6.8 (± 1.44)	3.84 (± 2.35)	0.29 (± 0.13)	3.92 (± 0.84)	0 (± 0)	74.33 (± 109.86)	0 (± 0)
Increased fishing pressure drivers - IM	2.34 (± 0.49)	3.3 (± 2.08)	0.18 (± 0.08)	4.11 (± 0.48)	0 (± 0)	74.33 (± 109.86)	0 (± 0)
High Cost, Low Values - IM	2.06 (± 0.44)	2.07 (± 1.36)	0.14 (± 0.07)	5.76 (± 1.13)	Major fishery	74.4 (± 109.97)	Active fishery

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
Low Costs, High Values - IM	2.34 (± 0.5)	3.17 (± 1.98)	0.17 (± 0.08)	4.39 (± 0.48)	Major fishery	74.52 (± 109.69)	Active fishery
Standard Markets - IM	2.35 (± 0.5)	3.27 (± 2.14)	0.18 (± 0.08)	4.51 (± 0.41)	0 (± 0)	74.33 (± 109.86)	0 (± 0)
Technology Creep - IM	4.6 (± 0.97)	3.5 (± 2.24)	0.38 (± 0.16)	6.22 (± 0.15)	0 (± 0)	74.33 (± 109.86)	0 (± 0)
No Acclimation - 2010 coastal context - IM	0.53 (± 0.11)	5.27 (± 3.32)	3.28 (± 1.52)	7.12 (± 0.84)	0 (± 0)	34.47 (± 50.27)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	0.51 (± 0.09)	4.63 (± 2.39)	2.95 (± 1.46)	6.68 (± 1.67)	0 (± 0)	49.18 (± 72.08)	0 (± 0)

Table A. 12: Mean relative landings (± s.e.) of each fished group in Atlantis-SEAP for each strategy-scenario combination under RCP 8.5. Landings are relative to model values in 2010. Note that distributions are actually asymmetrical as lowest possible landings is zero. For mesopelagics and new fisheries "Active fishery" or "Major fishery" is noted as there is no fishery initially.

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
No Climate change - 2010 context - SQ	0.47 (± 0.39)	1.15 (± 0.41)	44.39 (± 1.04)	4.94 (± 3.53)	20.81 (± 25.87)	1.36 (± 1.17)	4.1 (± 4.05)	0.39 (± 0.26)
2010 coastal context - Cap ecosystem take	1.12 (± 0.38)	1.02 (± 0.6)	47 (± 1.77)	128.24 (± 47.82)	15.49 (± 13.41)	0.08 (± 0.09)	4.83 (± 1.65)	0.34 (± 0.23)
2010 coastal context - Centralised mgmt.	1.12 (± 0.37)	0.82 (± 0.31)	46.39 (± 1.11)	127.23 (± 47.29)	14.61 (± 13.05)	0.04 (± 0.03)	5.58 (± 3.95)	0.33 (± 0.22)
2010 coastal context - FewMPA	1.12 (± 0.36)	0.37 (± 0.44)	26.22 (± 0.24)	132.79 (± 44.34)	12.47 (± 7.88)	0.24 (± 0.31)	4.84 (± 2.27)	0.35 (± 0.26)
2010 coastal context - Fragmented mgmt	1.12 (± 0.38)	0.91 (± 0.24)	47.03 (± 2.19)	127.83 (± 46.87)	18.45 (± 20.71)	0.06 (± 0.07)	25.18 (± 32.72)	0.39 (± 0.3)
2010 coastal context - ManyMPA	1.51 (± 0.42)	2.54 (± 0.97)	39.84 (± 6.89)	112.07 (± 39.69)	21.31 (± 7.7)	0.2 (± 0.25)	0.21 (± 0.25)	0.31 (± 0.2)
2010 coastal context - Seasons	1 (± 0.3)	0.66 (± 0.39)	28.91 (± 3.59)	0.92 (± 0.31)	3.41 (± 1.84)	0.37 (± 0.45)	4.04 (± 1.68)	0.04 (± 0.01)
2010 coastal context - SlowAssess	0.63 (± 0.36)	0.43 (± 0.28)	44.76 (± 7.85)	70.94 (± 51.6)	5.83 (± 4.92)	3.77 (± 3.27)	4.02 (± 2.71)	0.33 (± 0.23)
2010 coastal context - Integrated Mgmt (IM)	0.62 (± 0.35)	1.1 (± 0.67)	46.89 (± 3.85)	72 (± 55.04)	9.15 (± 7.51)	10.2 (± 13.73)	5.16 (± 2)	0.35 (± 0.23)
Cumulative impacts - 2010 Status Quo (SQ)	0.5 (± 0.34)	0.29 (± 0.19)	45.51 (± 1.3)	53.07 (± 22.43)	1.86 (± 1.38)	0.89 (± 0.19)	0 (± 0)	0.26 (± 0.09)
Cumulative impacts - Cap ecosystem take	0.5 (± 0.34)	0.3 (± 0.13)	45.89 (± 0.96)	53.32 (± 23.42)	2.67 (± 1.79)	0.64 (± 0.27)	0 (± 0)	0.27 (± 0.1)
Cumulative impacts - Centralised mgmt.	0.5 (± 0.34)	0.25 (± 0.03)	45.31 (± 1.39)	52.77 (± 22.46)	2.64 (± 1.78)	0.81 (± 0.71)	0 (± 0)	0.25 (± 0.09)
Cumulative impacts - FewMPA	0.5 (± 0.33)	0.15 (± 0.21)	25.64 (± 1.58)	55.45 (± 22.93)	2.11 (± 0.34)	1.38 (± 0.29)	0 (± 0)	0.26 (± 0.08)
Cumulative impacts - Fragmented mgmt	0.5 (± 0.34)	0.29 (± 0.05)	45.95 (± 2.32)	53.05 (± 22.45)	3 (± 3.04)	0.42 (± 0.11)	0 (± 0)	0.25 (± 0.09)
Cumulative impacts - ManyMPA	0.52 (± 0.37)	0.87 (± 0.48)	38.91 (± 6.62)	46.69 (± 19.89)	4.14 (± 1.16)	1.18 (± 0.26)	0 (± 0)	0.26 (± 0.1)
Cumulative impacts - Seasons	0.33 (± 0.22)	0.23 (± 0.16)	28.39 (± 5.05)	0.39 (± 0.16)	0.64 (± 0.23)	2.34 (± 0.39)	0 (± 0)	0.02 (± 0.01)
Cumulative impacts - SlowAssess	1.02 (± 0.58)	0.11 (± 0.02)	43.62 (± 1.28)	109.63 (± 54.23)	6.3 (± 6.76)	0.28 (± 0.48)	0 (± 0)	0.22 (± 0.06)
Cumulative impacts - IM	1.01 (± 0.56)	0.28 (± 0.12)	46.28 (± 5.39)	108.59 (± 51.05)	7.38 (± 5.25)	1.46 (± 2.51)	0 (± 0)	0.23 (± 0.06)
Expanded LTL fishery - IM	1.13 (± 0.38)	0.79 (± 0.26)	45.17 (± 0.72)	129.15 (± 47.49)	15.74 (± 10.33)	0.01 (± 0.01)	7.36 (± 5.04)	0.28 (± 0.12)
New mesopelgic fishery - IM	1.22 (± 0.42)	0.33 (± 0.22)	100.68 (± 8.68)	1.51 (± 0.55)	27.8 (± 29.68)	0.02 (± 0.03)	3.54 (± 1.1)	0.07 (± 0.02)

Scenario	Large planktivorous fish	Blue grenader	Small planktivorous fish	Ocean planktivores	Banded morwong	Shallow piscivorous fish	Shallow demersal reef fish	Large piscivorous fish (tuna)
Extreme climate events - IM	1.22 (± 0.4)	0.26 (± 0.16)	100.45 (± 5.83)	1.51 (± 0.56)	29.2 (± 30.35)	0.05 (± 0.05)	2.04 (± 1.73)	0.07 (± 0.02)
Blooms - IM	1.21 (± 0.41)	0.17 (± 0.12)	100.59 (± 6.61)	1.53 (± 0.59)	29.42 (± 30.57)	0.15 (± 0.18)	2.36 (± 3.63)	0.07 (± 0.02)
Primary production regime shift - IM	1.23 (± 0.39)	0.42 (± 0.23)	99.92 (± 6.57)	1.56 (± 0.56)	29.33 (± 30.26)	0.07 (± 0.08)	1.93 (± 1.33)	0.07 (± 0.02)
Fish kills - IM	1.21 (± 0.4)	0.18 (± 0.2)	100.59 (± 5.95)	1.5 (± 0.54)	27.27 (± 29.64)	0.07 (± 0.09)	2.09 (± 2.51)	0.07 (± 0.02)
Range extensions - IM	1.14 (± 0.4)	1 (± 0.53)	44.52 (± 4.37)	128.95 (± 49.16)	7.93 (± 2.84)	0.09 (± 0.11)	6.9 (± 3.41)	0.24 (± 0.06)
Gear switching allowed - IM	1.11 (± 0.37)	0.76 (± 0.3)	26.16 (± 0.63)	131.87 (± 44.3)	9.13 (± 3.65)	0.2 (± 0.31)	4.56 (± 2.82)	0.26 (± 0.1)
High compliance - IM	1.13 (± 0.38)	1.03 (± 0.7)	46.01 (± 1.37)	128.82 (± 47.36)	14.1 (± 8.34)	0.03 (± 0.03)	4.44 (± 1.03)	0.24 (± 0.09)
Low Compliance - IM	1.13 (± 0.38)	0.66 (± 0.41)	48.97 (± 2.13)	127.73 (± 45.03)	10.64 (± 5.48)	0.15 (± 0.18)	2.5 (± 2.19)	0.28 (± 0.1)
Flexible fisher behaviour - IM	2.52 (± 1.55)	1.09 (± 0.73)	121.63 (± 3.84)	356.47 (± 126.22)	14.9 (± 9.23)	0.01 (± 0.02)	4.3 (± 2.03)	0.25 (± 0.05)
Increased fishing pressure drivers - IM	1.12 (± 0.38)	1.02 (± 0.6)	47 (± 1.77)	128.24 (± 47.82)	15.49 (± 13.41)	0.14 (± 0.18)	4.83 (± 1.65)	0.22 (± 0.05)
High Cost, Low Values - IM	1.12 (± 0.36)	0.5 (± 0.03)	26.08 (± 0.26)	133.03 (± 45.23)	19.58 (± 13.09)	0.23 (± 0.3)	4.79 (± 2.04)	0.28 (± 0.07)
Low Costs, High Values - IM	1.12 (± 0.37)	1.23 (± 1.01)	46.93 (± 1.94)	128.44 (± 46.58)	17.54 (± 20.29)	0.02 (± 0.03)	4.21 (± 3.82)	0.3 (± 0.07)
Standard Markets - IM	1.13 (± 0.38)	0.93 (± 0.76)	46.59 (± 1.33)	127.89 (± 46.96)	10.94 (± 10.09)	0.14 (± 0.17)	4.8 (± 3.99)	0.26 (± 0.08)
Technology Creep - IM	1.73 (± 1.06)	0.74 (± 0.16)	73.33 (± 7.31)	254.64 (± 87.37)	20.4 (± 4.57)	0.08 (± 0.13)	5.23 (± 3.06)	0.34 (± 0.15)
No Acclimation - 2010 coastal context - IM	0 (± 0)	4.43 (± 2.59)	0.51 (± 0.02)	5.51 (± 2.05)	0 (± 0)	0.01 (± 0)	0 (± 0)	0.26 (± 0.06)
No Acclimation - Cumulative impacts - SQ	0 (± 0)	3.52 (± 3.63)	0.49 (± 0.03)	5.51 (± 2)	0 (± 0)	0.01 (± 0.02)	0 (± 0)	0.26 (± 0.06)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
No Climate change - 2010 context - SQ	0.96 (± 0.85)	0 (± 0)	0 (± 0)	9.71 (± 10.99)	15.51 (± 4.44)	28.86 (± 25.33)	20.33 (± 16.28)	2.87 (± 1.91)
2010 coastal context - Cap ecosystem take	0.31 (± 0.17)	0 (± 0)	0 (± 0)	10.23 (± 10.12)	130.86 (± 75.76)	10.98 (± 5.27)	25.47 (± 6.85)	813.21 (± 885.04)
2010 coastal context - Centralised mgmt.	0.96 (± 0.66)	0 (± 0)	0 (± 0)	4.25 (± 1.37)	123.68 (± 52.28)	17.65 (± 8.55)	27.03 (± 11.34)	341.41 (± 307.43)
2010 coastal context - FewMPA	0.46 (± 0.32)	0 (± 0)	0 (± 0)	13.81 (± 12.14)	159.11 (± 46.12)	53.63 (± 29.13)	34.47 (± 8.41)	271.89 (± 438.65)
2010 coastal context - Fragmented mgmt	0.76 (± 0.32)	0 (± 0)	0 (± 0)	52.01 (± 72.06)	142.45 (± 37.04)	13.17 (± 10.74)	26.05 (± 8.01)	611.38 (± 784.29)
2010 coastal context - ManyMPA	0.83 (± 0.44)	0 (± 0)	0 (± 0)	25.66 (± 23.51)	2.44 (± 3.09)	1.84 (± 3.18)	35.88 (± 7.36)	1901.65 (± 2154.58)
2010 coastal context - Seasons	1.06 (± 0.92)	0 (± 0)	0 (± 0)	31.91 (± 33.28)	88.42 (± 91.75)	53.44 (± 34.87)	28.69 (± 5.87)	475.07 (± 742.12)
2010 coastal context - SlowAssess	0.86 (± 0.3)	0 (± 0)	0 (± 0)	47.68 (± 76.32)	130.78 (± 48.18)	11.26 (± 6.54)	29.7 (± 4.17)	153.8 (± 211.73)
2010 coastal context - Integrated Mgmt (IM)	0.45 (± 0.36)	0 (± 0)	0 (± 0)	5.49 (± 3.24)	128.49 (± 38.75)	10.23 (± 7.39)	34.94 (± 8.4)	269.85 (± 356.79)
Cumulative impacts - 2010 Status Quo (SQ)	0.75 (± 0.38)	0 (± 0)	0 (± 0)	48.43 (± 40.69)	20.92 (± 23.84)	0 (± 0)	22.06 (± 9.87)	15.73 (± 12.67)
Cumulative impacts - Cap ecosystem take	0.75 (± 0.56)	0 (± 0)	0 (± 0)	41.1 (± 66.44)	30.66 (± 45.32)	0 (± 0)	25.48 (± 12.65)	26.26 (± 13.69)
Cumulative impacts - Centralised mgmt.	1.09 (± 0.45)	0 (± 0)	0 (± 0)	62.94 (± 54.19)	19.49 (± 24.23)	0 (± 0)	25.67 (± 14.14)	13.67 (± 4.68)

Scenario	Flatheads	Migratory mesopelagics fish	Non-migratory mesopelagics fish	Purple wrasse	Deep demersal fish	Shallow demersal herbivores	Other shallow demersal fish	Magpie perch
Cumulative impacts - FewMPA	0.82 (± 0.22)	0 (± 0)	0 (± 0)	3.34 (± 2.3)	33.78 (± 37.8)	0 (± 0)	29 (± 12.27)	16.34 (± 14.81)
Cumulative impacts - Fragmented mgmt	0.73 (± 0.37)	0 (± 0)	0 (± 0)	47.19 (± 39.82)	37.82 (± 53.29)	0 (± 0)	23.69 (± 17.57)	17.1 (± 15.46)
Cumulative impacts - ManyMPA	0.33 (± 0.05)	0 (± 0)	0 (± 0)	6.12 (± 3.15)	0.82 (± 1.32)	0 (± 0)	30.05 (± 10.48)	72.33 (± 37.31)
Cumulative impacts - Seasons	0.45 (± 0.47)	0 (± 0)	0 (± 0)	7.72 (± 6.57)	7.07 (± 6.45)	0 (± 0)	27.08 (± 7.09)	32.27 (± 31.12)
Cumulative impacts - SlowAssess	0.94 (± 0.4)	0 (± 0)	0 (± 0)	24.92 (± 38.14)	20.26 (± 26.87)	0 (± 0)	20.13 (± 13.94)	110.46 (± 183.05)
Cumulative impacts - IM	0.2 (± 0.03)	0 (± 0)	0 (± 0)	43.18 (± 64.69)	25.55 (± 38.69)	0 (± 0)	20.9 (± 11.68)	237.72 (± 397.66)
Expanded LTL fishery - IM	1.14 (± 0.33)	0 (± 0)	0 (± 0)	4.78 (± 1.96)	192.41 (± 29.44)	20.22 (± 14.46)	30.76 (± 7.55)	250.02 (± 220.19)
New mesopelgic fishery - IM	0.45 (± 0.3)	Major fishery	Major fishery	5 (± 1.81)	48.46 (± 17.26)	19.77 (± 9.95)	31.17 (± 11.47)	384.39 (± 443.42)
Extreme climate events - IM	0.37 (± 0.19)	0 (± 0)	0 (± 0)	9.19 (± 1.68)	22.51 (± 25.7)	3.14 (± 5.36)	31.13 (± 6.5)	666.22 (± 582.52)
Blooms - IM	0.35 (± 0.13)	0 (± 0)	0 (± 0)	9.36 (± 2.55)	25.57 (± 26.71)	5.65 (± 9.69)	35.44 (± 9.02)	712.31 (± 622.61)
Primary production regime shift - IM	0.33 (± 0.2)	0 (± 0)	0 (± 0)	8.05 (± 2.88)	70.5 (± 60.24)	26.62 (± 40.34)	34.32 (± 9.95)	539.29 (± 472.55)
Fish kills - IM	0.4 (± 0.19)	0 (± 0)	0 (± 0)	9.76 (± 2.18)	24.07 (± 26.77)	4.25 (± 7.32)	30.82 (± 14.54)	754.46 (± 690.6)
Range extensions - IM	0.67 (± 0.71)	0 (± 0)	0 (± 0)	7.19 (± 5.9)	128.68 (± 51.26)	24.76 (± 10.12)	29.87 (± 5.86)	580.05 (± 558.26)
Gear switching allowed - IM	0.99 (± 0.71)	0 (± 0)	0 (± 0)	10.88 (± 8.18)	113.11 (± 100.38)	53.2 (± 36.26)	30.82 (± 5.48)	400.98 (± 353.53)
High compliance - IM	0.92 (± 0.58)	0 (± 0)	0 (± 0)	4.19 (± 0.75)	145.34 (± 111.31)	16.08 (± 6.72)	26.47 (± 5.79)	314.02 (± 283.3)
Low Compliance - IM	0.86 (± 0.73)	0 (± 0)	0 (± 0)	10.65 (± 9.76)	107.41 (± 41.31)	4.51 (± 6.23)	27.39 (± 2.79)	318.34 (± 317.94)
Flexible fisher behaviour - IM	0.4 (± 0.32)	0 (± 0)	0 (± 0)	4.89 (± 0.96)	152.19 (± 52.54)	33.36 (± 41.11)	31.34 (± 5.77)	371.17 (± 369.86)
Increased fishing pressure drivers - IM	0.31 (± 0.17)	0 (± 0)	0 (± 0)	10.22 (± 10.13)	130.86 (± 75.76)	10.98 (± 5.27)	24.71 (± 7.01)	813.21 (± 885.04)
High Cost, Low Values - IM	0.43 (± 0.23)	0 (± 0)	0 (± 0)	50.83 (± 72.01)	174.41 (± 66.58)	57.5 (± 38.47)	37.66 (± 2.72)	315.51 (± 409.91)
Low Costs, High Values - IM	1.12 (± 0.8)	0 (± 0)	0 (± 0)	25.95 (± 17.47)	151.44 (± 90.26)	12.65 (± 8.85)	32.97 (± 5.86)	2134.06 (± 2999.64)
Standard Markets - IM	0.77 (± 0.36)	0 (± 0)	0 (± 0)	10.87 (± 7.03)	137.93 (± 46.06)	14.78 (± 8.65)	27.19 (± 8.03)	553.89 (± 670.54)
Technology Creep - IM	0.63 (± 0.48)	0 (± 0)	0 (± 0)	19.44 (± 15.76)	129.7 (± 32.99)	47.71 (± 23.96)	35.37 (± 6.71)	673.76 (± 791.04)
No Acclimation - 2010 coastal context - IM	1.08 (± 0.61)	0 (± 0)	0 (± 0)	36.11 (± 35.7)	168.27 (± 72.35)	0 (± 0)	29.86 (± 17.16)	2869.98 (± 3123.47)
No Acclimation - Cumulative impacts - SQ	0.64 (± 0.57)	0 (± 0)	0 (± 0)	23.83 (± 28.9)	195.26 (± 82.45)	0 (± 0)	23.02 (± 15.44)	1954.64 (± 2366.64)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Climate change - 2010 context - SQ	0 (± 0)	21288.64 (± 26347.33)	2.7 (± 1.91)	1.28 (± 0.88)	1.24 (± 1.86)	36.88 (± 0.28)	1.5 (± 0.02)	0.39 (± 0.01)
2010 coastal context - Cap ecosystem take	0 (± 0)	856.09 (± 170.15)	3.92 (± 3.67)	0.92 (± 0.47)	0.92 (± 0.08)	34.72 (± 5.67)	0.11 (± 0.06)	0.32 (± 0.1)
2010 coastal context - Centralised mgmt.	0 (± 0)	861.83 (± 137.93)	2.73 (± 3.65)	0.86 (± 0.61)	0.93 (± 0.1)	33.84 (± 3.8)	0.1 (± 0.04)	0.25 (± 0.09)
2010 coastal context - FewMPA	0 (± 0)	521.35 (± 87.11)	0.86 (± 0.57)	1.5 (± 1.11)	0.56 (± 0.06)	41.44 (± 14.29)	0.03 (± 0.01)	0.32 (± 0.24)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
2010 coastal context - Fragmented mgmt	0 (± 0)	575.97 (± 210.07)	2.33 (± 1.9)	1.47 (± 0.67)	0.94 (± 0.1)	36.68 (± 1.92)	0.1 (± 0.05)	0.26 (± 0.06)
2010 coastal context - ManyMPA	0 (± 0)	739.86 (± 158.77)	8.97 (± 7.37)	0.59 (± 0.54)	0.98 (± 0.13)	29.39 (± 5.08)	0.02 (± 0.01)	0.3 (± 0.17)
2010 coastal context - Seasons	0 (± 0)	722.53 (± 339.43)	1.68 (± 0.8)	1.51 (± 1.02)	1.42 (± 2)	4.56 (± 1.92)	0.04 (± 0.01)	0.56 (± 0.3)
2010 coastal context - SlowAssess	0 (± 0)	751.77 (± 227.22)	1.9 (± 2.35)	0.64 (± 0.45)	1.15 (± 0.84)	30.66 (± 9.74)	0.03 (± 0.04)	0.04 (± 0.07)
2010 coastal context - Integrated Mgmt (IM)	0 (± 0)	630.24 (± 72.34)	3.36 (± 3.93)	0.82 (± 0.57)	1.09 (± 0.79)	32.79 (± 13.35)	0.05 (± 0.08)	0.13 (± 0.22)
Cumulative impacts - 2010 Status Quo (SQ)	0 (± 0)	588.61 (± 182.59)	0.27 (± 0.22)	0.52 (± 0.53)	1.59 (± 1.03)	29.47 (± 11.5)	0 (± 0)	0 (± 0)
Cumulative impacts - Cap ecosystem take	0 (± 0)	552.42 (± 221.19)	0.45 (± 0.24)	0.43 (± 0.55)	1.47 (± 0.93)	31.26 (± 11.75)	0 (± 0)	0 (± 0)
Cumulative impacts - Centralised mgmt.	0 (± 0)	663.15 (± 82.11)	0.24 (± 0.08)	0.8 (± 1.09)	1.49 (± 0.96)	28.55 (± 11.07)	0 (± 0)	0 (± 0)
Cumulative impacts - FewMPA	0 (± 0)	623.56 (± 522.93)	0.68 (± 0.47)	1.14 (± 1.33)	0.82 (± 0.51)	28.82 (± 8.01)	0 (± 0)	0 (± 0)
Cumulative impacts - Fragmented mgmt	0 (± 0)	667.59 (± 341.74)	0.29 (± 0.27)	0.6 (± 0.66)	1.51 (± 0.96)	29.29 (± 11.19)	0 (± 0)	0 (± 0)
Cumulative impacts - ManyMPA	0 (± 0)	719.4 (± 193.67)	1.25 (± 0.64)	0.62 (± 0.83)	1.58 (± 1.02)	29.86 (± 13.78)	0 (± 0)	0 (± 0)
Cumulative impacts - Seasons	0 (± 0)	578.08 (± 411.05)	0.56 (± 0.54)	1.51 (± 1.13)	0.47 (± 0.31)	2.46 (± 1.1)	0 (± 0)	0 (± 0)
Cumulative impacts - SlowAssess	0 (± 0)	854.34 (± 504.15)	0.35 (± 0.24)	0.5 (± 0.7)	1.31 (± 0.65)	36.51 (± 4.89)	0.02 (± 0.02)	0.06 (± 0.09)
Cumulative impacts - IM	0 (± 0)	1020.79 (± 186.12)	0.69 (± 0.58)	0.85 (± 1.12)	1.29 (± 0.51)	39.22 (± 8.58)	0.02 (± 0.01)	0.06 (± 0.08)
Expanded LTL fishery - IM	0 (± 0)	793.31 (± 100.06)	1.63 (± 1.88)	1.5 (± 0.78)	1.04 (± 0.21)	42.16 (± 10.54)	0.1 (± 0.03)	0.22 (± 0.04)
New mesopelgic fishery - IM	0 (± 0)	939.04 (± 215.16)	3.78 (± 5.44)	1.73 (± 0.83)	0.8 (± 0.11)	7.46 (± 3.4)	0.02 (± 0.02)	0.46 (± 0.35)
Extreme climate events - IM	0 (± 0)	889.23 (± 475.13)	5.24 (± 6.53)	1.73 (± 0.21)	0.73 (± 0.05)	7.44 (± 3.37)	0.02 (± 0.01)	0.46 (± 0.22)
Blooms - IM	0 (± 0)	802.44 (± 577.33)	5.51 (± 7.02)	1.65 (± 0.5)	0.78 (± 0.12)	7.54 (± 3.6)	0.02 (± 0.01)	0.29 (± 0.14)
Primary production regime shift - IM	0 (± 0)	710.64 (± 267.63)	3.7 (± 3.87)	1.75 (± 0.18)	0.74 (± 0.05)	7.68 (± 3.36)	0.03 (± 0.02)	0.43 (± 0.21)
Fish kills - IM	0 (± 0)	542.93 (± 279.43)	6.27 (± 8.24)	1.81 (± 0.38)	0.71 (± 0.09)	7.4 (± 3.28)	0.02 (± 0.01)	0.38 (± 0.26)
Range extensions - IM	0 (± 0)	827.91 (± 286.3)	3.26 (± 3.49)	1.51 (± 0.92)	0.89 (± 0.18)	40.39 (± 3.02)	0.08 (± 0.03)	0.19 (± 0.06)
Gear switching allowed - IM	0 (± 0)	420.87 (± 390.85)	2.49 (± 3.24)	0.69 (± 0.25)	0.5 (± 0.06)	43.34 (± 3.03)	0.17 (± 0.05)	0.19 (± 0.11)
High compliance - IM	0 (± 0)	736.95 (± 12.41)	2.57 (± 3.34)	1.12 (± 0.07)	0.94 (± 0.11)	38.57 (± 4.16)	0.14 (± 0.1)	0.33 (± 0.13)
Low Compliance - IM	0 (± 0)	451.77 (± 403.79)	1.65 (± 1.86)	1.37 (± 1.08)	1.04 (± 0.17)	33.61 (± 3.97)	0.12 (± 0.05)	0.3 (± 0.16)
Flexible fisher behaviour - IM	0 (± 0)	941.14 (± 285.72)	3.27 (± 4.58)	1.15 (± 0.49)	1.74 (± 0.59)	41.52 (± 8.18)	0.13 (± 0.09)	0.31 (± 0.15)
Increased fishing pressure drivers - IM	0 (± 0)	901.31 (± 125.15)	3.92 (± 3.67)	0.92 (± 0.47)	0.92 (± 0.08)	37.34 (± 2.52)	0.11 (± 0.06)	0.32 (± 0.1)
High Cost, Low Values - IM	8.79 (± 6.39)	358.24 (± 171.33)	1.19 (± 0.93)	1.87 (± 0.72)	1.9 (± 2.38)	45.31 (± 8.99)	0.09 (± 0.02)	0.33 (± 0.18)
Low Costs, High Values - IM	4.07 (± 1.95)	746.25 (± 75.98)	23.21 (± 35.54)	0.79 (± 0.45)	0.93 (± 0.09)	36.06 (± 2.17)	0.12 (± 0.08)	0.3 (± 0.14)
Standard Markets - IM	0 (± 0)	675.4 (± 216.64)	2.29 (± 1.98)	1.8 (± 0.81)	0.94 (± 0.12)	37.76 (± 1.78)	0.11 (± 0.08)	0.25 (± 0.13)
Technology Creep - IM	6.29 (± 6.7)	897.29 (± 344.65)	3 (± 2.44)	1.51 (± 0.31)	1.45 (± 0.27)	47.46 (± 2.39)	0.13 (± 0.04)	0.26 (± 0.14)
No Acclimation - 2010 coastal context - IM	0 (± 0)	686.71 (± 209.33)	13.85 (± 12.97)	0 (± 0)	0.09 (± 0.07)	27.16 (± 12.35)	0.95 (± 0.54)	0.48 (± 0.15)

Scenario	Shallow territorial demersal fish	Herring cale	Blue throat wrasse	Pink snapper	Warehous and trevalla	Striped tuna	Green eye dogfish	Demersal sharks
No Acclimation - Cumulative impacts - SQ	0 (± 0)	629.97 (± 296.03)	8.07 (± 7.03)	0 (± 0)	0.1 (± 0.07)	27.16 (± 12.17)	0.92 (± 0.77)	0.35 (± 0.21)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
No Climate change - 2010 context - SQ	3.17 (± 2.16)	1.36 (± 1.02)	0.45 (± 0.59)	7.02 (± 0.14)	13.81 (± 8.21)	0.04 (± 0.01)	0.63 (± 0.22)	1.29 (± 0.81)
2010 coastal context - Cap ecosystem take	22.24 (± 16.01)	0.2 (± 0.01)	1.12 (± 0.07)	7.56 (± 1.5)	0.56 (± 0.24)	0 (± 0)	0.42 (± 0.27)	8.64 (± 11.17)
2010 coastal context - Centralised mgmt.	120.73 (± 183.25)	0.2 (± 0.01)	0.95 (± 0.17)	7.75 (± 1.08)	0.57 (± 0.24)	0 (± 0)	0.43 (± 0.3)	288.16 (± 499.01)
2010 coastal context - FewMPA	46.8 (± 63.26)	0.25 (± 0.02)	0.02 (± 0.03)	4.62 (± 1.45)	0.46 (± 0.2)	0 (± 0)	0.25 (± 0.19)	10.98 (± 16.21)
2010 coastal context - Fragmented mgmt	114.76 (± 163.09)	0.2 (± 0.01)	1.26 (± 0.47)	7.16 (± 1.02)	0.57 (± 0.24)	0 (± 0)	0.42 (± 0.27)	5.41 (± 2.55)
2010 coastal context - ManyMPA	59.4 (± 95.27)	0.22 (± 0.02)	0.05 (± 0.05)	0.03 (± 0.01)	1.14 (± 0.47)	0 (± 0)	0.16 (± 0.08)	4.41 (± 1.09)
2010 coastal context - Seasons	30.81 (± 27.39)	0.98 (± 0.07)	0.01 (± 0.01)	9.09 (± 1.64)	0.47 (± 0.2)	0 (± 0)	0.32 (± 0.2)	1524.49 (± 2596.02)
2010 coastal context - SlowAssess	8.25 (± 7.12)	0.89 (± 0.58)	0.29 (± 0.49)	47.01 (± 35.05)	4.89 (± 6.27)	0 (± 0)	0.44 (± 0.3)	1198.73 (± 1132.8)
2010 coastal context - Integrated Mgmt (IM)	3.95 (± 3.56)	0.7 (± 0.44)	0.08 (± 0.05)	55.25 (± 41.13)	1.9 (± 1.31)	0 (± 0)	0.42 (± 0.27)	8.71 (± 7.56)
Cumulative impacts - 2010 Status Quo (SQ)	3.54 (± 4.26)	0.94 (± 0.03)	0.07 (± 0.09)	33.85 (± 1.01)	2.65 (± 0.88)	0 (± 0)	0.36 (± 0.25)	1368.65 (± 2370.19)
Cumulative impacts - Cap ecosystem take	4.9 (± 3.44)	0.95 (± 0.03)	0.06 (± 0.07)	34.59 (± 0.96)	2.63 (± 0.87)	0 (± 0)	0.37 (± 0.25)	395 (± 683.87)
Cumulative impacts - Centralised mgmt.	7.72 (± 4.37)	0.95 (± 0.03)	0.05 (± 0.07)	35.74 (± 2.07)	2.64 (± 0.88)	0 (± 0)	0.38 (± 0.27)	46.9 (± 81.23)
Cumulative impacts - FewMPA	4.15 (± 0.61)	1.19 (± 0.07)	0 (± 0)	20.9 (± 4.15)	2.16 (± 0.71)	0 (± 0)	0.22 (± 0.17)	48.24 (± 83.39)
Cumulative impacts - Fragmented mgmt	6.2 (± 5.24)	0.95 (± 0.04)	0.07 (± 0.09)	33.02 (± 1.63)	2.64 (± 0.88)	0 (± 0)	0.37 (± 0.25)	701.77 (± 1211.63)
Cumulative impacts - ManyMPA	2.18 (± 3.63)	1.05 (± 0.06)	0.01 (± 0.01)	0.13 (± 0.02)	5.3 (± 1.67)	0 (± 0)	0.14 (± 0.07)	895.4 (± 1548.68)
Cumulative impacts - Seasons	1.69 (± 0.72)	4.61 (± 0.29)	0 (± 0)	41.91 (± 5.45)	2.19 (± 0.74)	0 (± 0)	0.28 (± 0.19)	7.68 (± 13.06)
Cumulative impacts - SlowAssess	52.68 (± 55.02)	0.55 (± 0.5)	0.07 (± 0.05)	15.29 (± 18.1)	1.79 (± 1.49)	0 (± 0)	0.38 (± 0.28)	0.86 (± 1.21)
Cumulative impacts - IM	13.61 (± 14.8)	0.45 (± 0.43)	0.07 (± 0.04)	13.96 (± 18.6)	1.49 (± 1.72)	0 (± 0)	0.37 (± 0.25)	1.48 (± 1.09)
Expanded LTL fishery - IM	107.71 (± 140.42)	0.2 (± 0.01)	0.74 (± 0.32)	8.23 (± 1.61)	0.57 (± 0.24)	0 (± 0)	0.43 (± 0.29)	2.85 (± 3.27)
New mesopelgic fishery - IM	22.04 (± 15.3)	0.25 (± 0.01)	1.26 (± 0.2)	9.84 (± 3.04)	0.82 (± 0.35)	0 (± 0)	0.49 (± 0.34)	0.3 (± 0.19)
Extreme climate events - IM	100.83 (± 148.87)	0.26 (± 0.01)	1.18 (± 0.18)	9.12 (± 2.66)	0.81 (± 0.34)	0 (± 0)	0.46 (± 0.29)	0.47 (± 0.2)
Blooms - IM	63.1 (± 88.5)	0.27 (± 0.03)	1.48 (± 0.11)	8.82 (± 0.94)	0.81 (± 0.35)	0 (± 0)	0.47 (± 0.28)	2 (± 2.03)
Primary production regime shift - IM	96.18 (± 140.07)	0.3 (± 0.07)	0.8 (± 0.63)	12.77 (± 7.1)	1.62 (± 1.38)	0 (± 0)	0.46 (± 0.28)	0.95 (± 1.02)
Fish kills - IM	96.77 (± 152.22)	0.27 (± 0.01)	1.2 (± 0.13)	8.61 (± 1.43)	0.81 (± 0.35)	0 (± 0)	0.46 (± 0.29)	0.99 (± 0.6)
Range extensions - IM	90.47 (± 129.78)	0.21 (± 0.02)	0.85 (± 0.64)	11.5 (± 7.32)	0.91 (± 0.43)	0 (± 0)	0.44 (± 0.31)	6.06 (± 2.9)
Gear switching allowed - IM	46.39 (± 26.63)	0.2 (± 0.03)	0.04 (± 0.02)	7.41 (± 1.05)	0.55 (± 0.24)	0 (± 0)	0.39 (± 0.27)	2.48 (± 1.84)
High compliance - IM	131.55 (± 209.25)	0.2 (± 0.01)	0.89 (± 0.11)	8.5 (± 1.95)	0.56 (± 0.24)	0 (± 0)	0.44 (± 0.3)	0.35 (± 0.49)
Low Compliance - IM	46.6 (± 50.05)	0.21 (± 0.02)	1.06 (± 0.15)	7.07 (± 0.83)	0.57 (± 0.24)	0 (± 0)	0.45 (± 0.3)	1.24 (± 0.88)

Scenario	Spiky dogshark	Pelagic sharks	Gummy shark	Skates and rays	Urchins	Abalone	Lobster	Cephalopod
Flexible fisher behaviour - IM	119.75 (± 179.36)	0.24 (± 0)	0.9 (± 0.04)	7.98 (± 1.03)	1.63 (± 0.7)	0 (± 0)	0.51 (± 0.35)	0.53 (± 0.38)
Increased fishing pressure drivers - IM	141.05 (± 220.9)	0.2 (± 0.01)	1.12 (± 0.07)	7.56 (± 1.5)	0.56 (± 0.24)	0 (± 0)	0.42 (± 0.27)	17 (± 9.85)
High Cost, Low Values - IM	7.36 (± 6.66)	0.23 (± 0.02)	0 (± 0)	5.04 (± 1.1)	0.51 (± 0.22)	0 (± 0)	0.26 (± 0.16)	999.69 (± 1726.24)
Low Costs, High Values - IM	19.46 (± 8.38)	0.2 (± 0.01)	0.67 (± 0.5)	7.55 (± 1.55)	0.57 (± 0.24)	0 (± 0)	0.41 (± 0.27)	6.63 (± 8.46)
Standard Markets - IM	30.92 (± 17.03)	0.2 (± 0.01)	1.06 (± 0.37)	7.37 (± 1.24)	0.57 (± 0.24)	0 (± 0)	0.42 (± 0.27)	4.23 (± 3.74)
Technology Creep - IM	69.21 (± 53.92)	0.27 (± 0.02)	0.1 (± 0.09)	12.68 (± 1.25)	1.13 (± 0.48)	0 (± 0)	0.46 (± 0.31)	0.55 (± 0.11)
No Acclimation - 2010 coastal context - IM	18.92 (± 18.78)	10.73 (± 0.37)	0.01 (± 0)	7.22 (± 1.43)	7.74 (± 3.28)	0.01 (± 0)	0.68 (± 0.43)	11.39 (± 8.48)
No Acclimation - Cumulative impacts - SQ	69.07 (± 109.62)	10.6 (± 0.55)	0.01 (± 0)	5.92 (± 2.99)	7.16 (± 2.3)	0.01 (± 0)	0.65 (± 0.46)	8470.71 (± 14457.42)

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
No Climate change - 2010 context - SQ	7.96 (± 0.59)	1.92 (± 0.09)	0.44 (± 0.27)	4.08 (± 0.27)	0 (± 0)	7.39 (± 0.48)	0 (± 0)
2010 coastal context - Cap ecosystem take	8.33 (± 0.05)	1.85 (± 0.04)	0.13 (± 0.02)	4.1 (± 0.13)	0 (± 0)	9.14 (± 2.16)	0 (± 0)
2010 coastal context - Centralised mgmt.	8.34 (± 0.05)	1.85 (± 0.14)	0.14 (± 0.02)	3.98 (± 0.53)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
2010 coastal context - FewMPA	7.09 (± 0.03)	1.04 (± 0.15)	0.08 (± 0.01)	4.08 (± 0.26)	0 (± 0)	10.41 (± 0.03)	0 (± 0)
2010 coastal context - Fragmented mgmt	8.34 (± 0.05)	1.84 (± 0.1)	0.14 (± 0.02)	4.35 (± 0.16)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
2010 coastal context - ManyMPA	8.81 (± 0.12)	0.72 (± 0.1)	0.04 (± 0)	1.51 (± 0.24)	0 (± 0)	10.43 (± 0.03)	0 (± 0)
2010 coastal context - Seasons	4.92 (± 0.02)	1.37 (± 0.03)	0.13 (± 0.02)	4.24 (± 0.06)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
2010 coastal context - SlowAssess	40.47 (± 33.03)	1.37 (± 0.33)	0.46 (± 0.45)	4.45 (± 0.54)	0 (± 0)	6.52 (± 3.74)	0 (± 0)
2010 coastal context - Integrated Mgmt (IM)	28.65 (± 17.56)	1.36 (± 0.39)	0.23 (± 0.1)	4.34 (± 0.6)	0 (± 0)	5.41 (± 1.6)	0 (± 0)
Cumulative impacts - 2010 Status Quo (SQ)	36.23 (± 0.18)	0.97 (± 0.01)	0.22 (± 0.01)	0.84 (± 0.04)	0 (± 0)	6.24 (± 0.02)	0 (± 0)
Cumulative impacts - Cap ecosystem take	36.2 (± 0.2)	0.99 (± 0.04)	0.23 (± 0.01)	0.76 (± 0.02)	0 (± 0)	5.48 (± 1.3)	0 (± 0)
Cumulative impacts - Centralised mgmt.	36.23 (± 0.19)	0.98 (± 0.04)	0.23 (± 0.02)	0.74 (± 0.12)	0 (± 0)	6.24 (± 0.02)	0 (± 0)
Cumulative impacts - FewMPA	30.79 (± 0.11)	0.56 (± 0.09)	0.14 (± 0.02)	0.76 (± 0.06)	0 (± 0)	6.24 (± 0.02)	0 (± 0)
Cumulative impacts - Fragmented mgmt	36.21 (± 0.17)	0.98 (± 0.01)	0.23 (± 0.01)	0.81 (± 0.01)	0 (± 0)	6.24 (± 0.02)	0 (± 0)
Cumulative impacts - ManyMPA	38.27 (± 0.45)	0.39 (± 0.07)	0.06 (± 0)	0.07 (± 0.01)	0 (± 0)	6.26 (± 0.02)	0 (± 0)
Cumulative impacts - Seasons	21.36 (± 0.14)	0.73 (± 0.03)	0.21 (± 0.01)	1.58 (± 0.06)	0 (± 0)	6.24 (± 0.02)	0 (± 0)
Cumulative impacts - SlowAssess	19.62 (± 14.85)	1.43 (± 0.41)	0.24 (± 0.14)	1.23 (± 0.42)	0 (± 0)	8.84 (± 2.28)	0 (± 0)
Cumulative impacts - IM	17.24 (± 16.43)	1.4 (± 0.32)	0.15 (± 0.07)	1.2 (± 0.43)	0 (± 0)	5.61 (± 1.62)	0 (± 0)
Expanded LTL fishery - IM	8.35 (± 0.05)	1.87 (± 0.13)	0.14 (± 0.02)	4.41 (± 0.18)	Active fishery	10.42 (± 0.03)	Active fishery
New mesopelgic fishery - IM	9.35 (± 0.06)	2.05 (± 0.16)	0.17 (± 0.03)	2.98 (± 0.11)	0 (± 0)	10.42 (± 0.03)	0 (± 0)
Extreme climate events - IM	9.32 (± 0.06)	1.98 (± 0.07)	0.16 (± 0.02)	4.6 (± 1.43)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
Blooms - IM	9.32 (± 0.05)	2.07 (± 0.1)	0.17 (± 0.02)	5.39 (± 0.16)	0 (± 0)	10.4 (± 0.03)	0 (± 0)

Scenario	Other benthic filter feeder	Macrozoobenthos	Crabs	Prawns	Krill	Macroalgae	Jellies
Primary production regime shift - IM	12.07 (± 4.82)	2.05 (± 0.08)	0.32 (± 0.25)	3.81 (± 1.16)	0 (± 0)	8.57 (± 3.2)	0 (± 0)
Fish kills - IM	9.32 (± 0.06)	2.02 (± 0.03)	0.16 (± 0.02)	3.85 (± 1.52)	Active fishery	10.4 (± 0.03)	Major fishery
Range extensions - IM	10.88 (± 4.4)	1.88 (± 0.14)	0.25 (± 0.21)	4.3 (± 0.22)	0 (± 0)	10.41 (± 0.03)	0 (± 0)
Gear switching allowed - IM	7.81 (± 0.04)	1.68 (± 0.13)	0.14 (± 0.02)	3.16 (± 0.17)	0 (± 0)	10.41 (± 0.03)	0 (± 0)
High compliance - IM	8.33 (± 0.06)	1.91 (± 0.12)	0.14 (± 0.02)	4.05 (± 0.36)	Active fishery	10.4 (± 0.03)	Active fishery
Low Compliance - IM	8.32 (± 0.05)	1.94 (± 0.07)	0.14 (± 0.02)	3.84 (± 0.19)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
Flexible fisher behaviour - IM	24.18 (± 0.14)	2.18 (± 0.15)	0.22 (± 0.04)	3.88 (± 0.29)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
Increased fishing pressure drivers - IM	8.33 (± 0.05)	1.85 (± 0.04)	0.13 (± 0.02)	4.1 (± 0.13)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
High Cost, Low Values - IM	7.32 (± 0.03)	1.15 (± 0.05)	0.11 (± 0.02)	3.74 (± 1.4)	Active fishery	10.41 (± 0.03)	Active fishery
Low Costs, High Values - IM	8.34 (± 0.05)	1.78 (± 0.07)	0.13 (± 0.02)	4.38 (± 0.18)	Active fishery	10.59 (± 0.36)	Major fishery
Standard Markets - IM	8.34 (± 0.05)	1.82 (± 0.11)	0.14 (± 0.02)	4.51 (± 0.28)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
Technology Creep - IM	16.37 (± 0.09)	1.96 (± 0.15)	0.29 (± 0.05)	4.08 (± 1.4)	0 (± 0)	10.4 (± 0.03)	0 (± 0)
No Acclimation - 2010 coastal context - IM	1.88 (± 0.01)	2.96 (± 0.06)	2.5 (± 0.33)	3.55 (± 0.11)	0 (± 0)	5.05 (± 0.45)	0 (± 0)
No Acclimation - Cumulative impacts - SQ	1.84 (± 0.08)	2.71 (± 0.27)	2.26 (± 0.41)	3.41 (± 1.08)	0 (± 0)	7.08 (± 0.52)	0 (± 0)

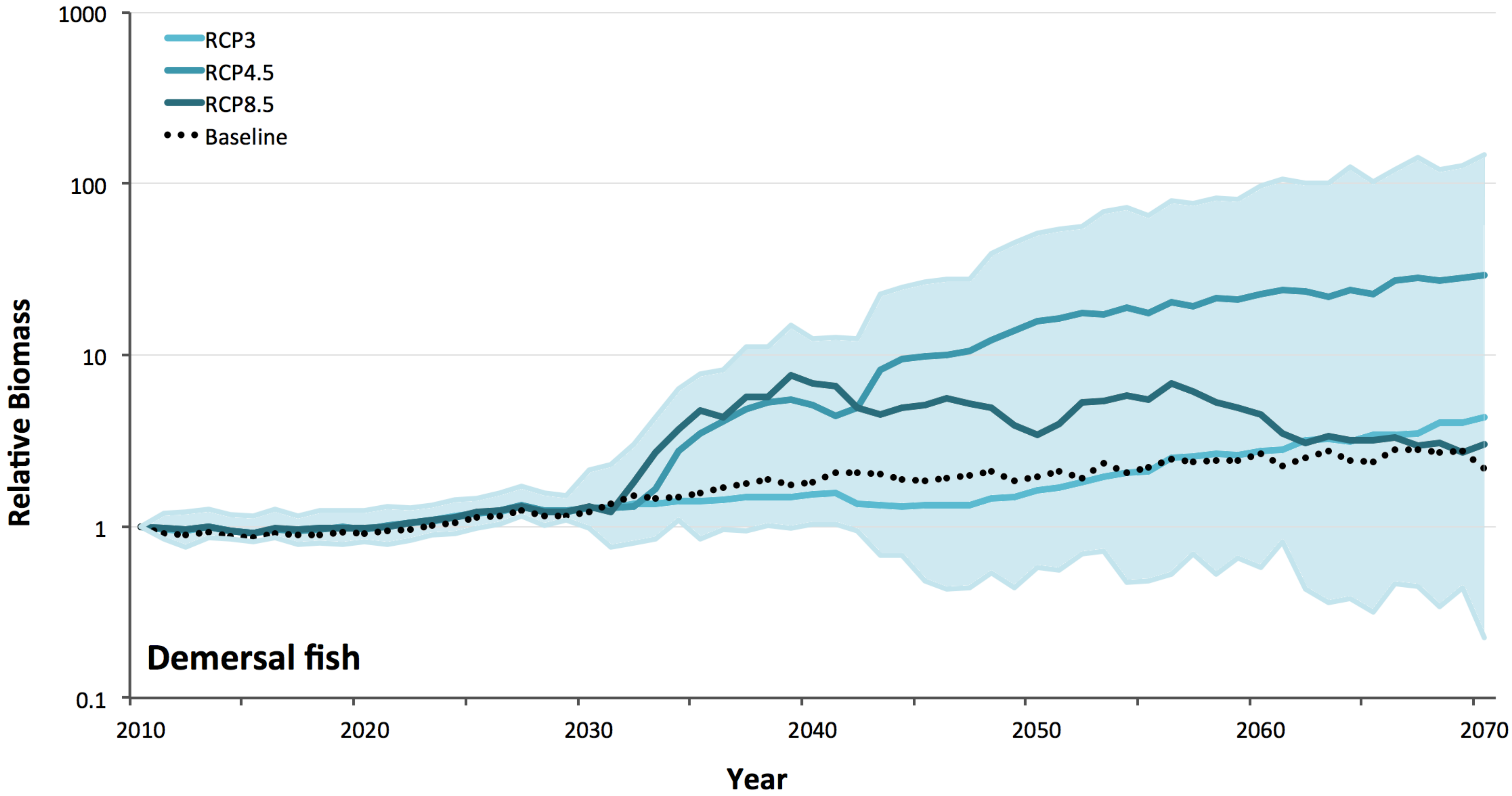


Figure A. 16: The average relative biomass of all demersal fish through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

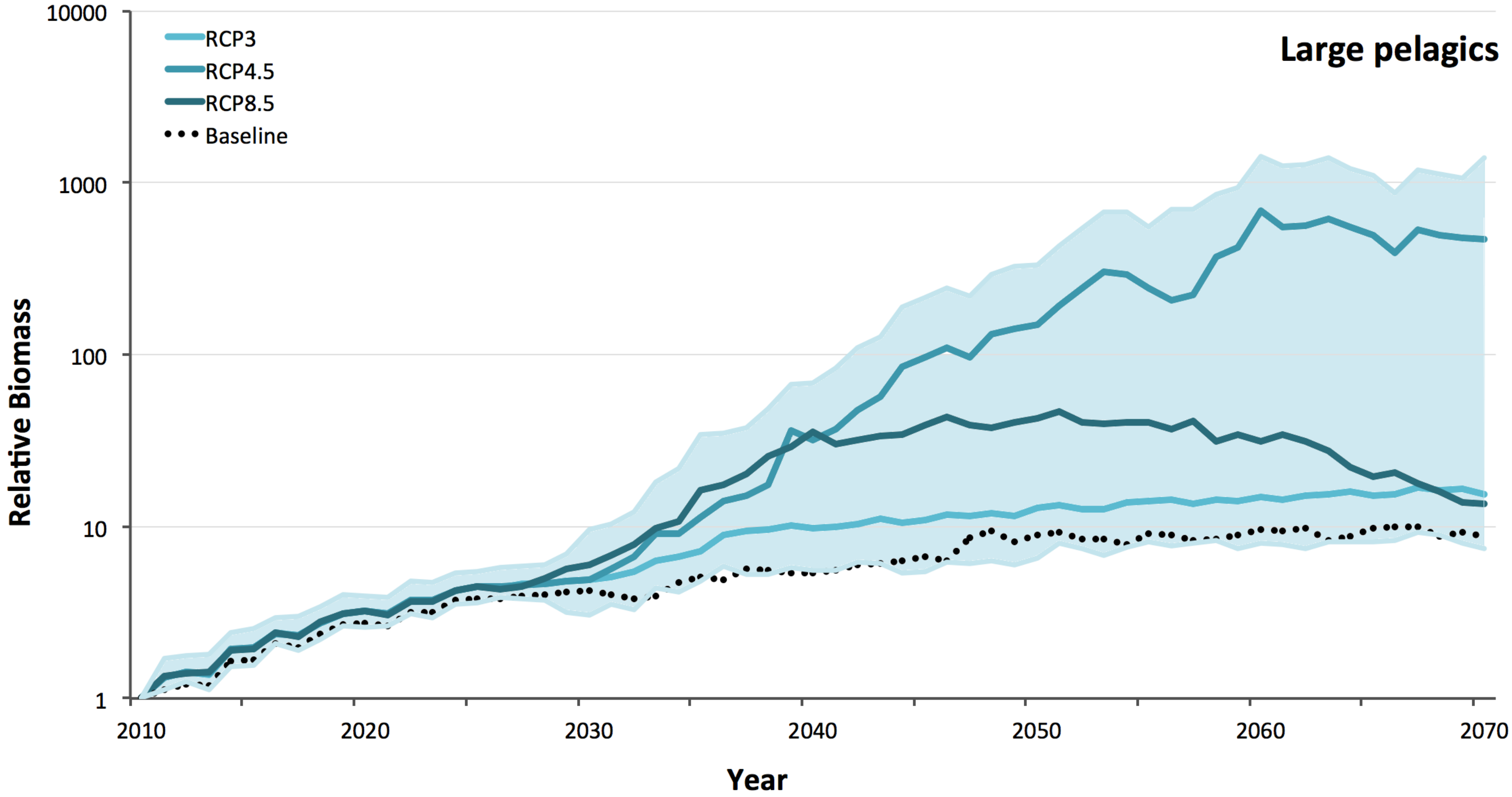


Figure A. 17: The average relative biomass of large pelagic fish through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

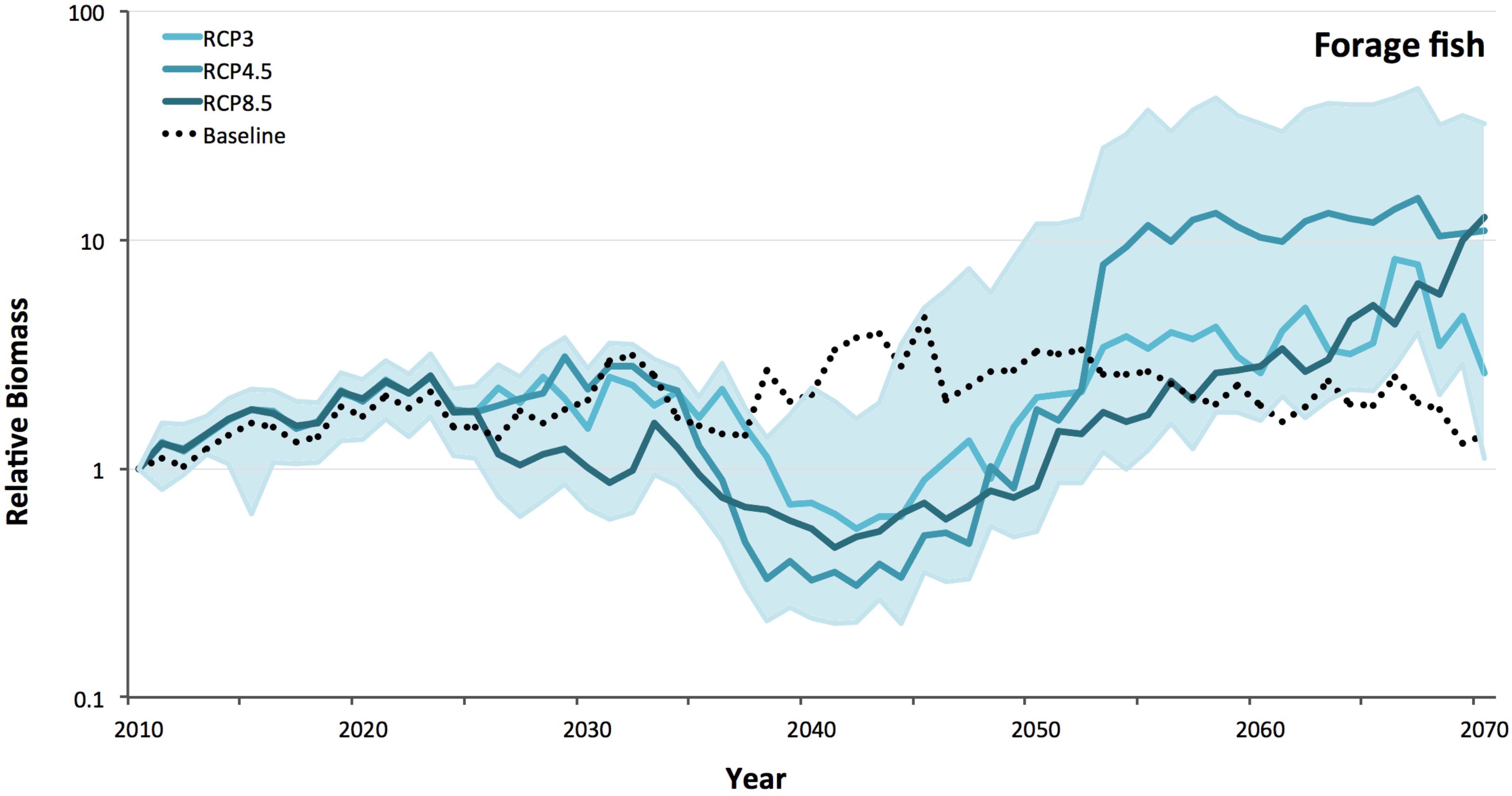


Figure A. 18: The average relative biomass of forage fish through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

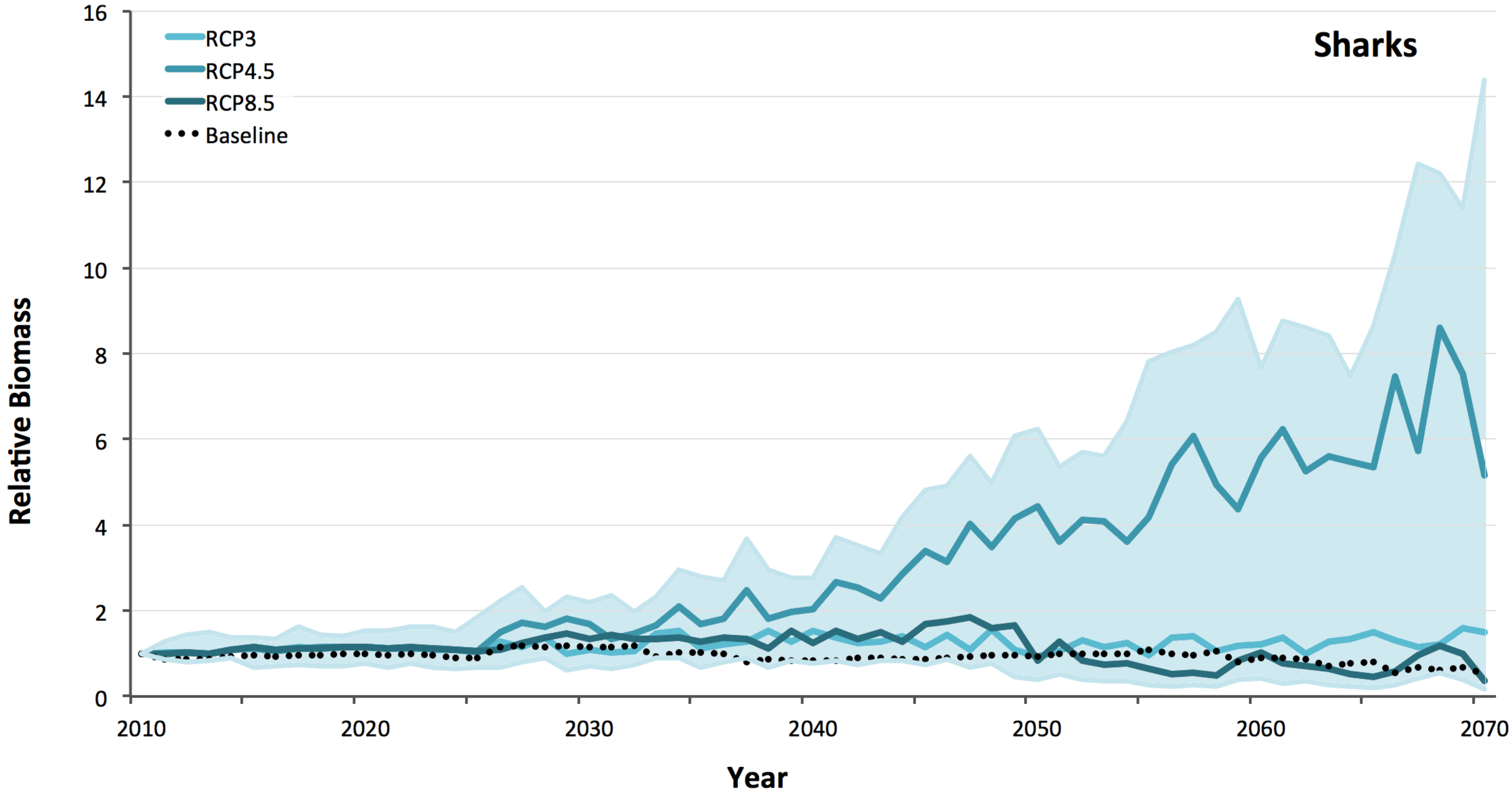


Figure A. 19: The average relative biomass of sharks through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

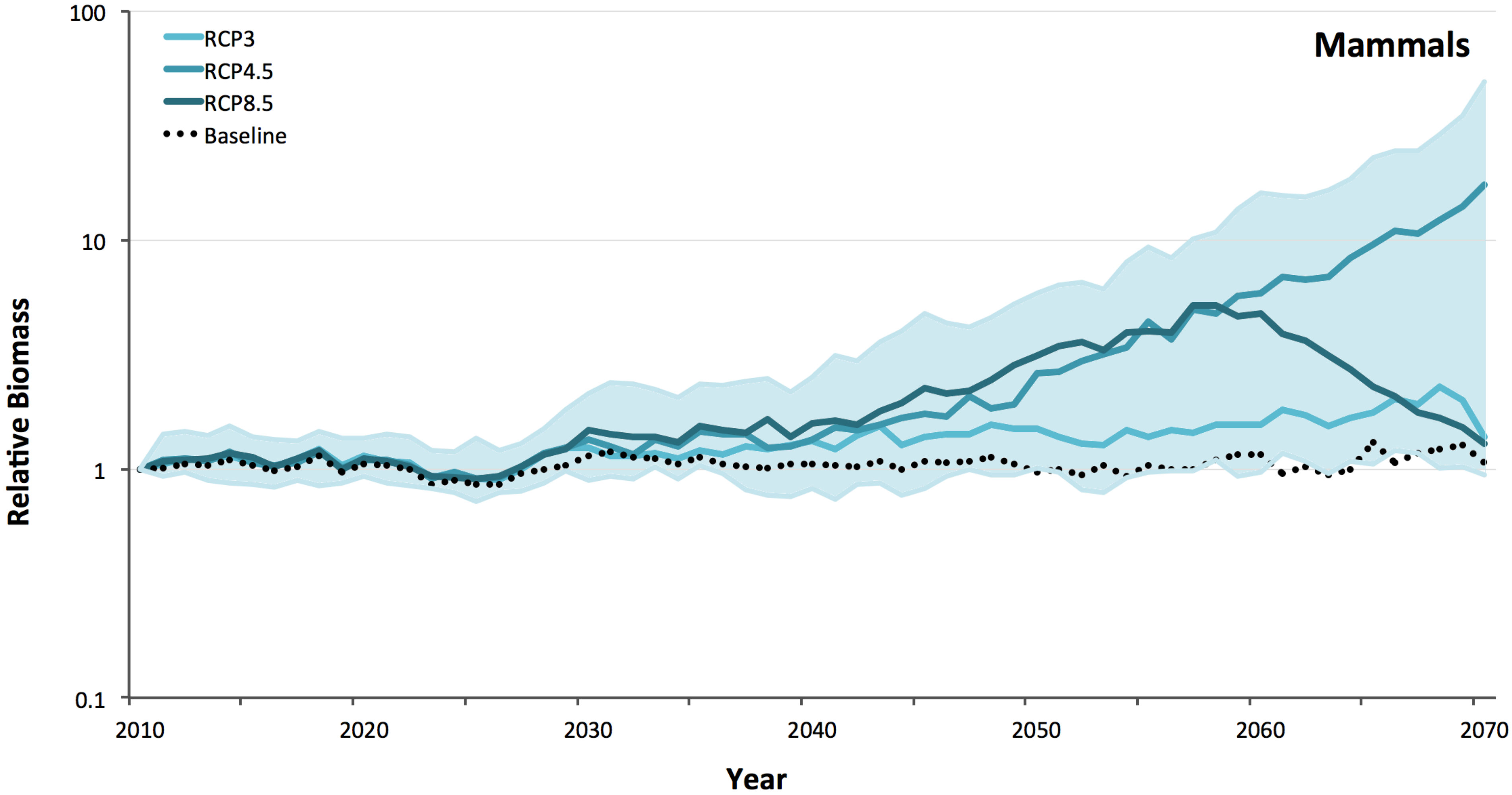


Figure A. 20: The average relative biomass of mammals through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

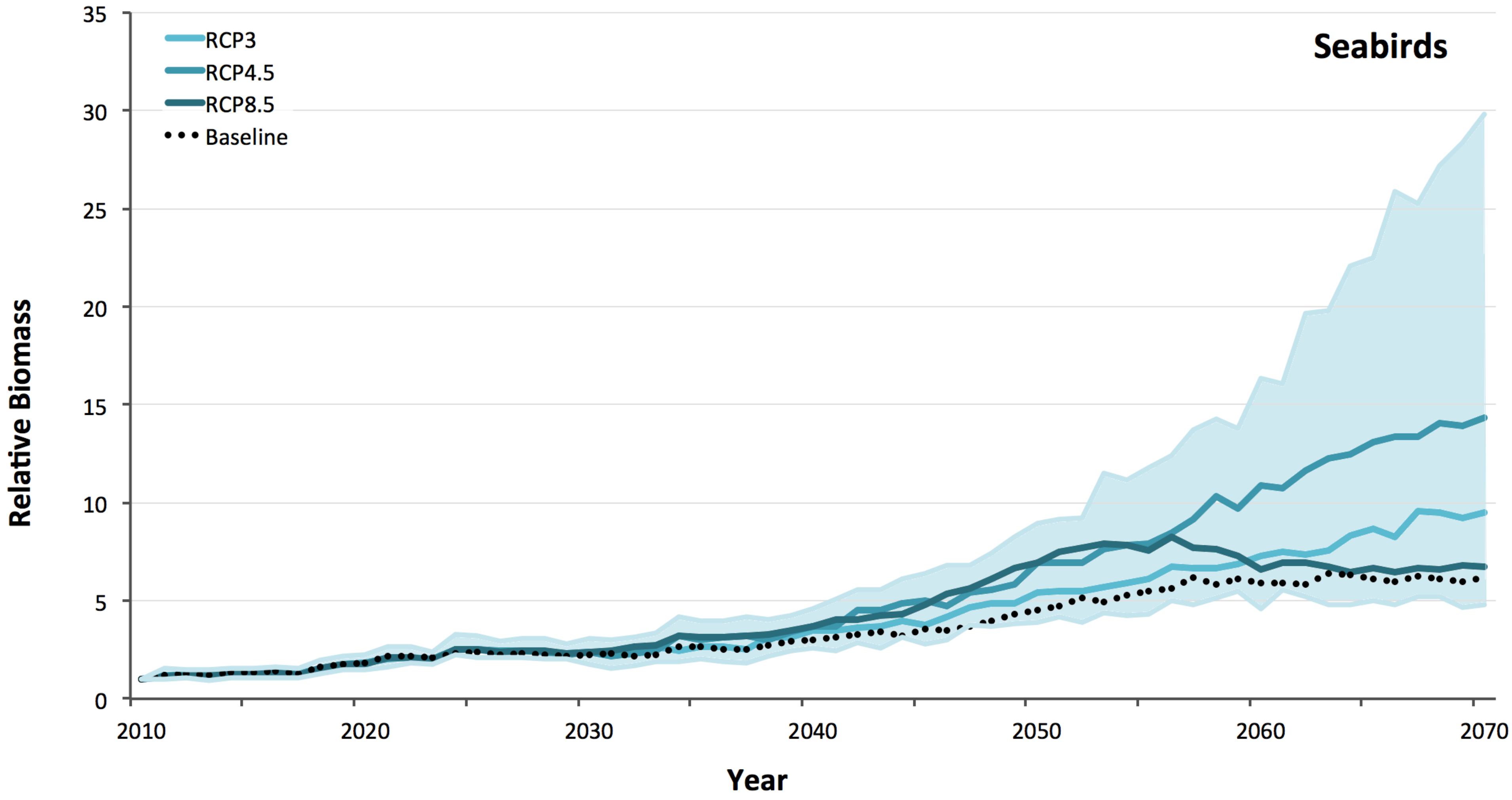


Figure A. 21: The average relative biomass of seabirds through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

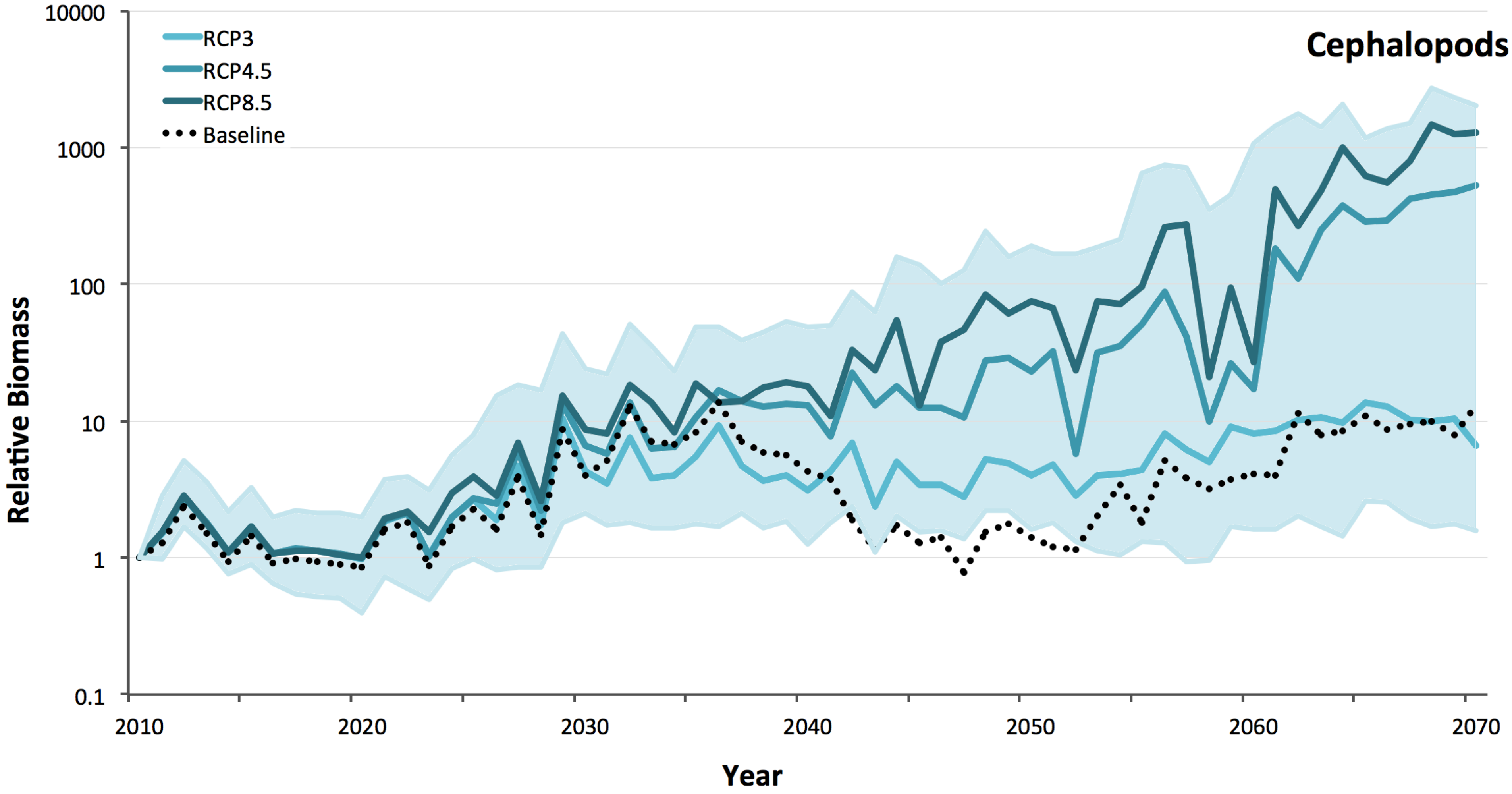


Figure A. 22: The average relative biomass of cephalopod through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

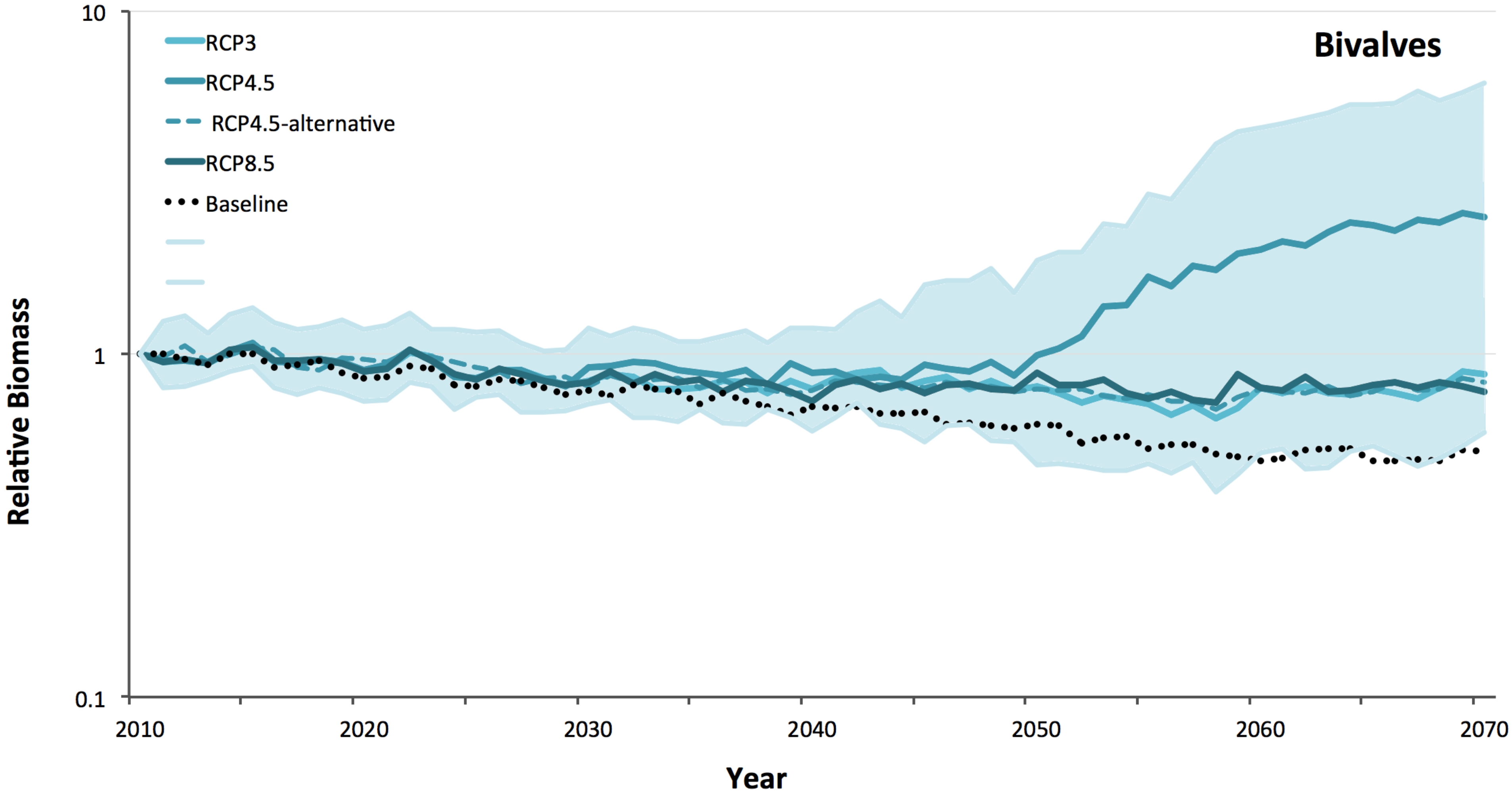


Figure A. 23: The average relative biomass of bivalves through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range. Note that the strong increase under RCP 4.5 comes largely from deep filter feeders under one parameterisation where the temperature benefits outweighed acidification impacts, the dashed line shows the alternative mean if that parameterisation is omitted.

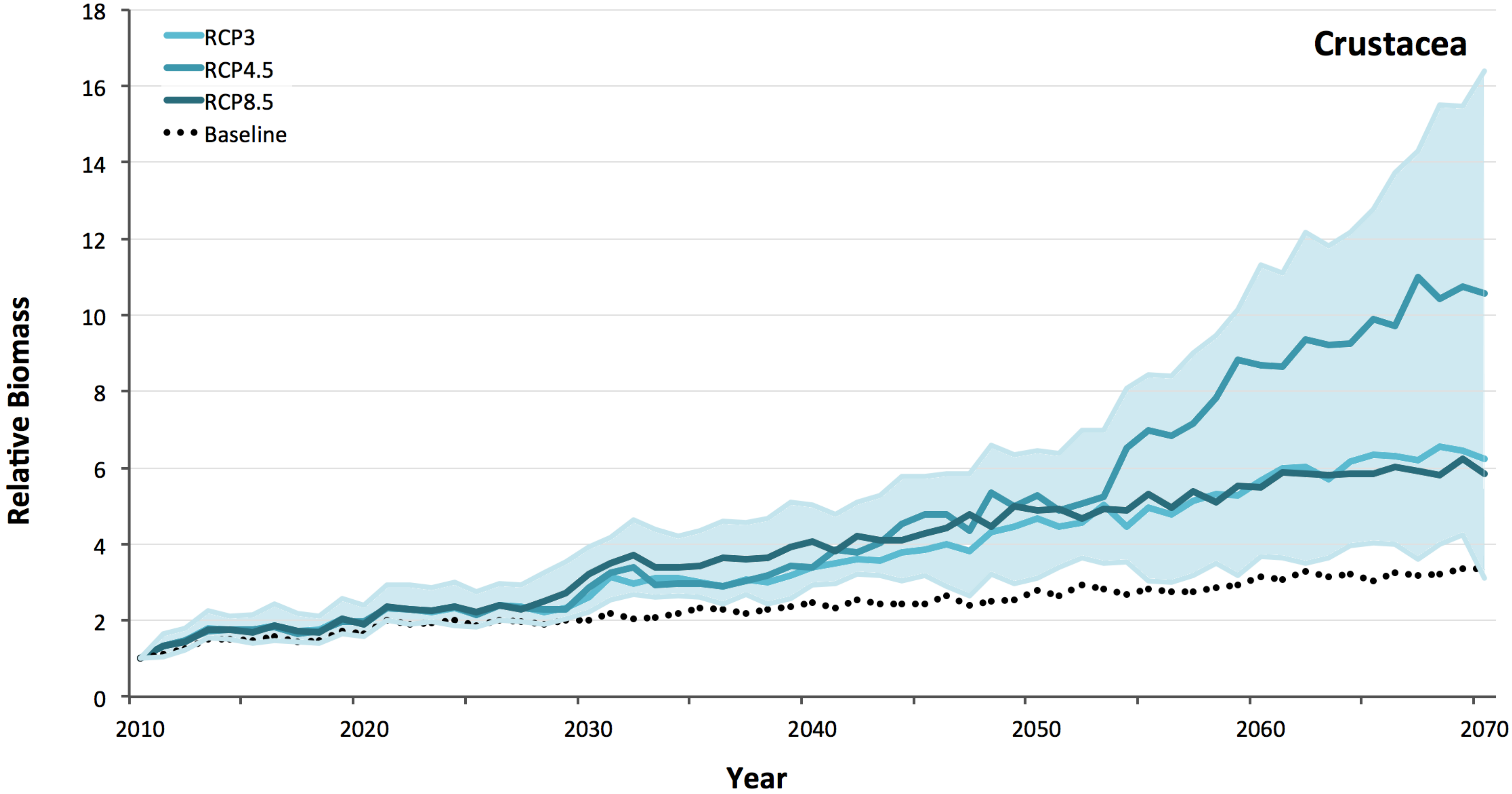


Figure A. 24: The average relative biomass of crustaceans through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

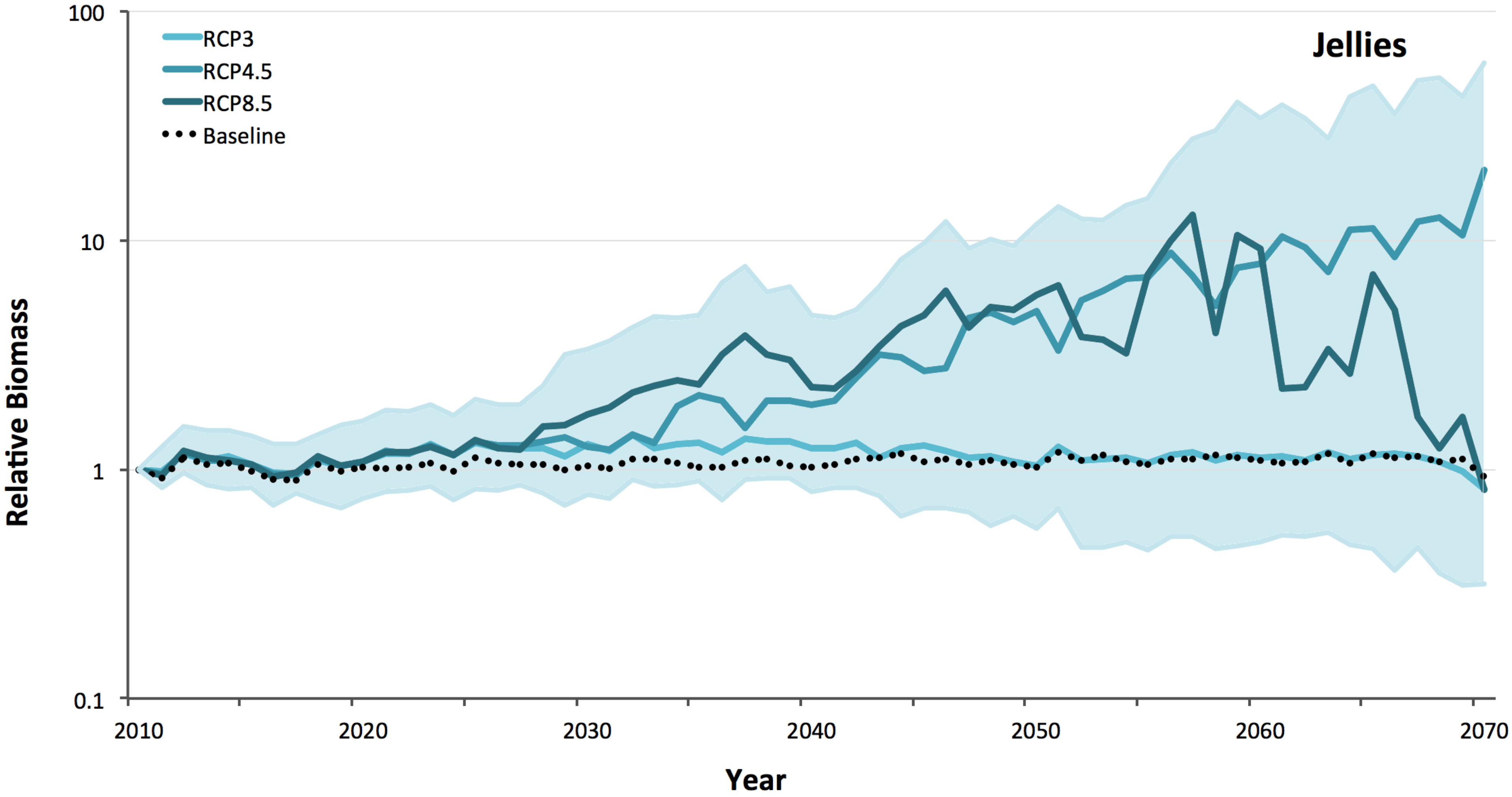


Figure A. 25: The average relative biomass of jellyfish through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

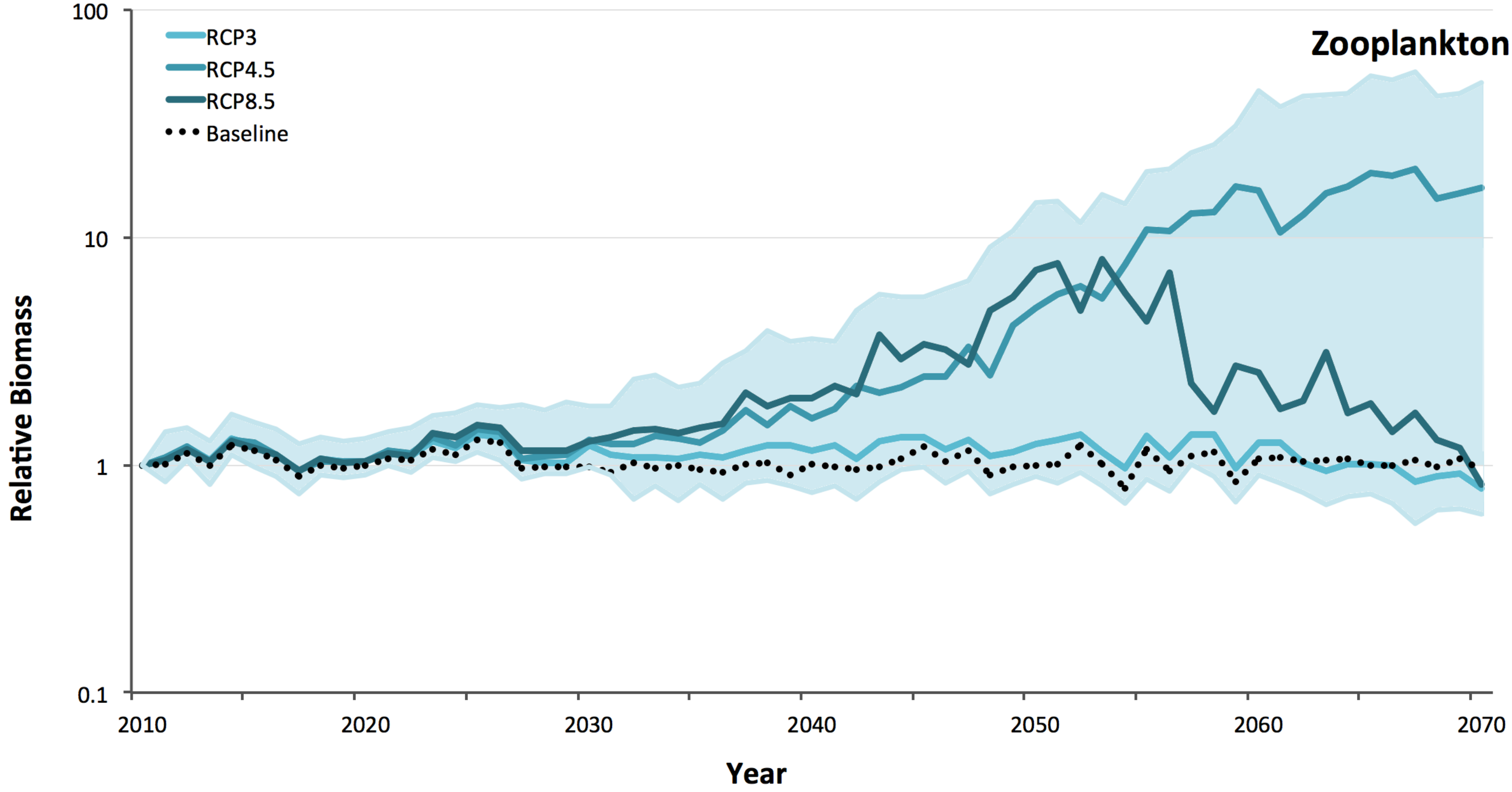


Figure A. 26: The average relative biomass of zooplankton through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

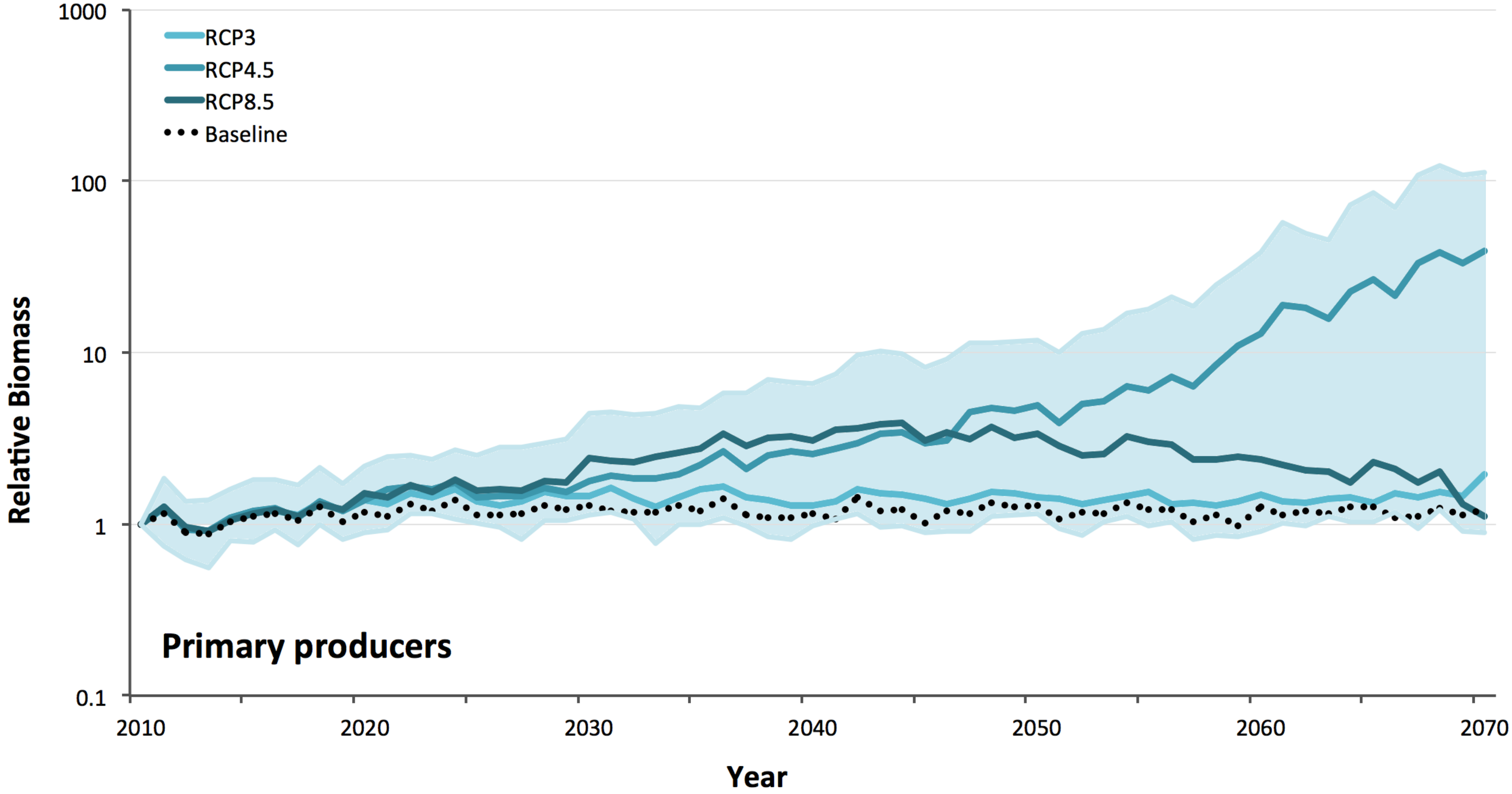


Figure A. 27: The average relative biomass of primary producers through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

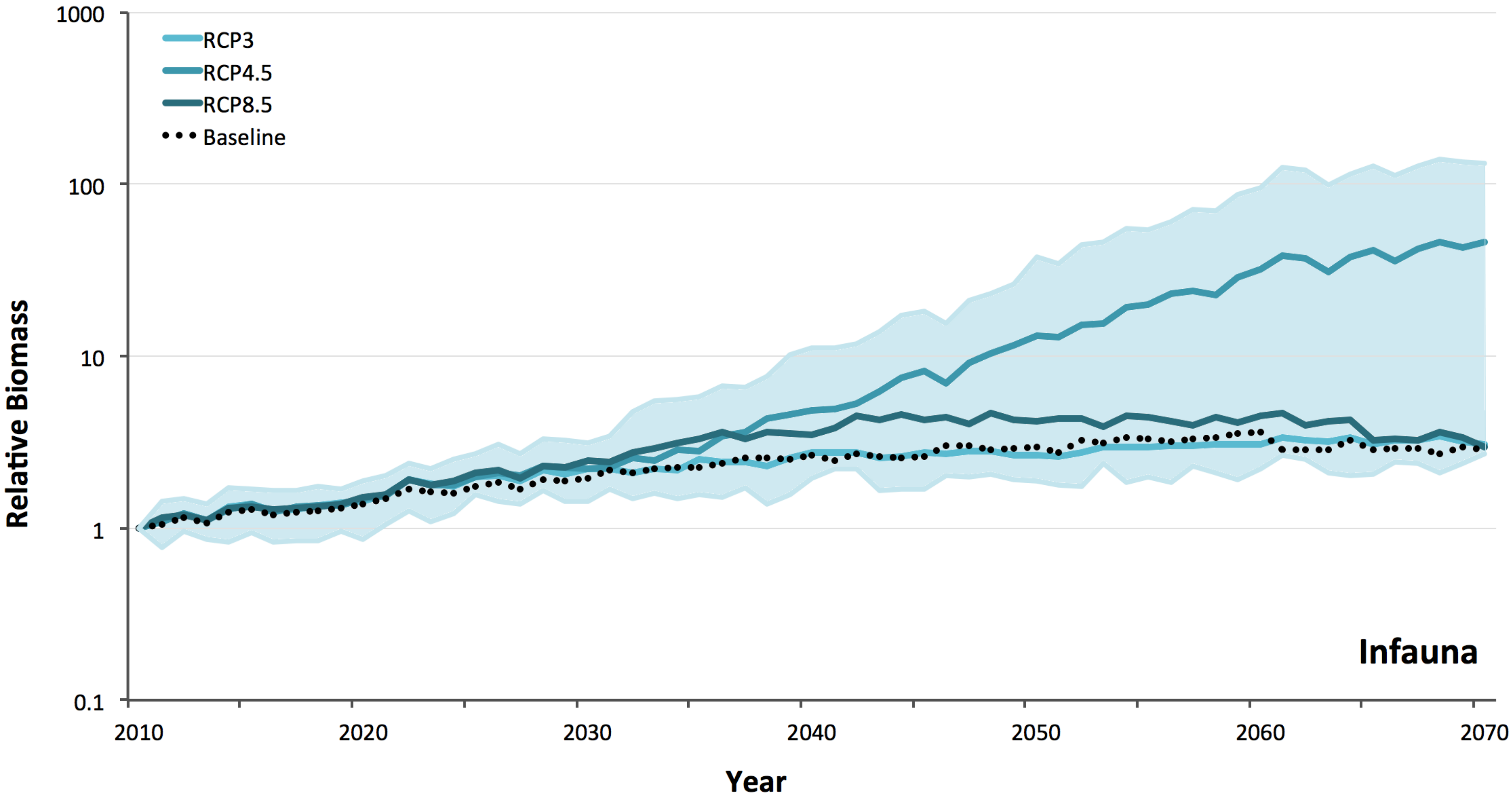


Figure A. 28: The average relative biomass of infauna through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

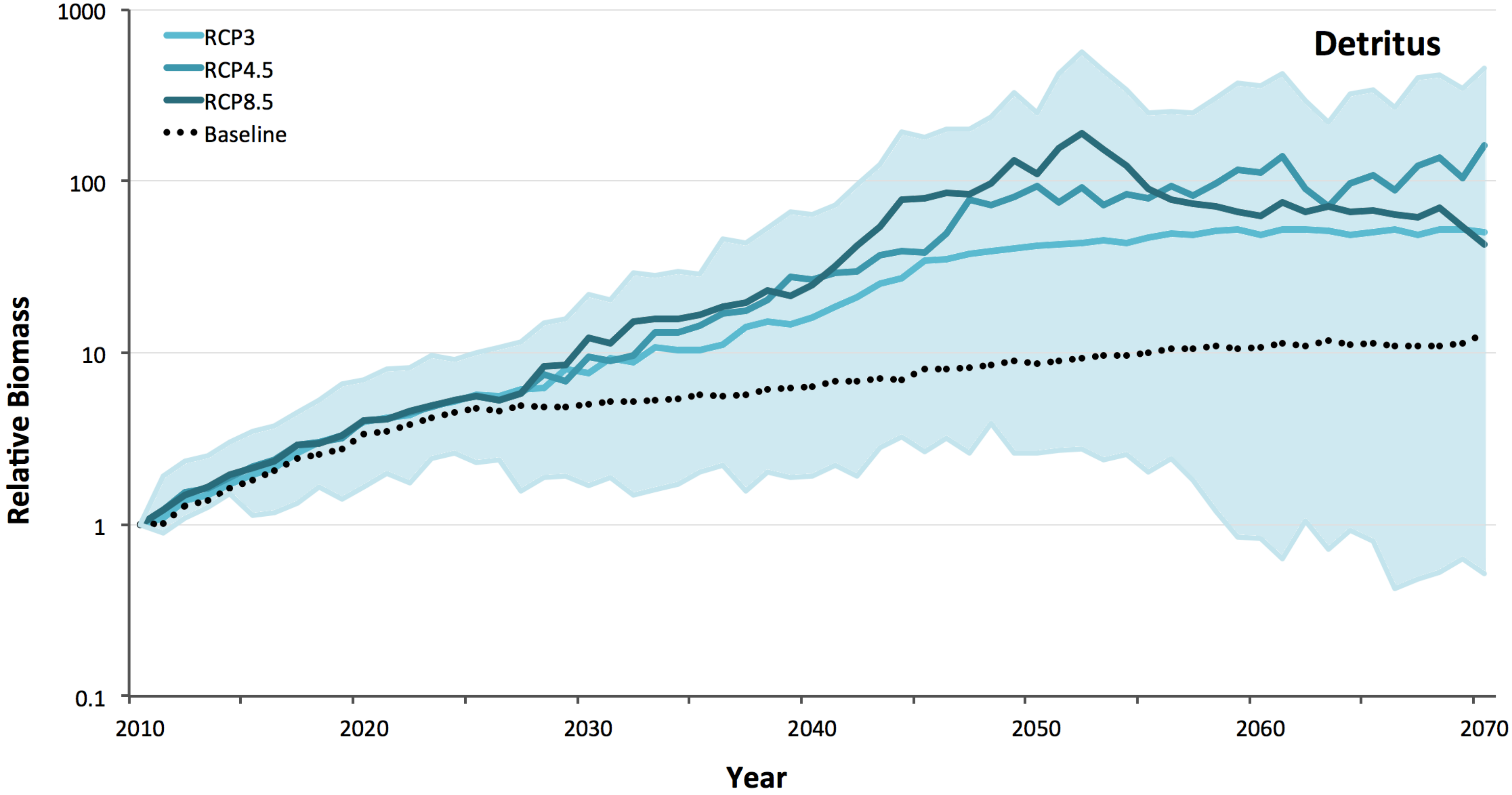


Figure A. 29: The average relative biomass of detritus through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

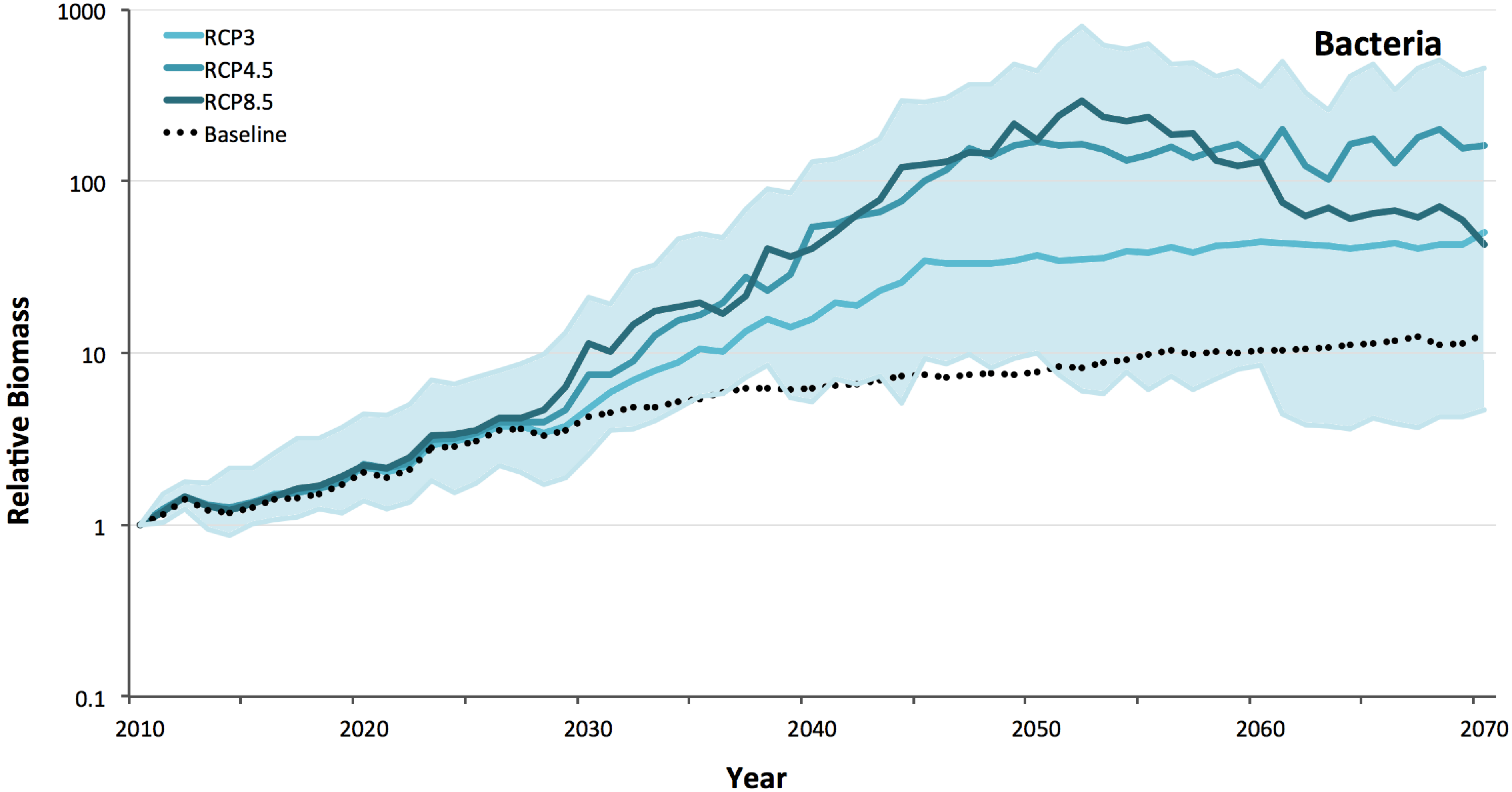


Figure A. 30: The average relative biomass of bacteria through time in Atlantis-SEAP under the different emission scenarios. The lighter shaded area is the total range.

Appendix B – Project staff

List of researchers and project staff:

- Elizabeth Fulton
- Penelope Johnson
- Miriana Sporcic
- Richard Smith
- David Smith
- Alistair Hobday

Other researchers associated with the project:

- Christopher Brown (UQ)
- Gary Griffith (UTAS, CSIRO)

Appendix C – Intellectual Property

Model based intellectual Property created during this project:

- refined Atlantis-SE model
- Atlantis-SEAP model
- updated Atlantis code to include acclimation and evolution

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CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

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Oceans & Atmosphere
Beth Fulton
t +61 3 6232 5018
e beth.fulton@csiro.au
w www.csiro.au